Menlo Park Notebook #66 [N-80-02-08.2]

This notebook covers the period March-April 1880. Most of the entries are by Charles L. Clarke. There are also a few entries by Edison and Francis Upton. Included are calculations and tables relating to conductors for the electric lighting system; calculations relating to tests of the system made by Professors Cyrus Fogg Brackett and Charles Augustus Young of Princeton; calculations, drawings, and notes on the shrinkage of carbonized filaments; drawings of pulleys and belts for a dynamo room; and notes on a "Trial of Rotary Engine Engineering Jan. 1, 1875." There are also a series of calculations by Edison about central stations and electric power distribution and a few calculations by Francis Upton about electric power distribution. The name "Clarke" is inscribed on the inside front cover. The inside back cover contains the notation: "Clarke Table of Volts - Ohms - Foot-lbs." There are 284 numbered pages, and the book has been used in both directions.

Filming order: pp. 1-201; pp. 284-202 [in reverse page-number order].

X E172 N-80-02-08.2

Clarke 1

62.39
62.339 68
9182
6

1728) 62.39 (.0361053240 7
5184
10550
10368
1820
1728
9200
8640
5600
5184
4160
3888
2720
2592
1280
1296

252.4956
7728
2096648
1764972
17677972
252495
4362439.968
6232.0567
57
5608
4546
5548

252.79
8.89
227.9966
227

62.39
56.91
5491
4912
4912
0861
5520

100

100 : 97 :: X : .2064

100 : 97 :: 1 : X
.2064

97 : 100 :: .2064 : X
100

97) 20.6400 (.2128
194
270
258
120
97
23

.55
.59
180
180
9

180
97
60
58
2

2064.003824
140
152960
38240
9) 1535360
059948.49

.14

πR²
π(2R)²
π4R²

490
455

2 $\left(\frac{140}{9}\right)^2 =$

140
140
5600
140
19600
.0000126
117600
39200
19600

81).0246960 (.000304888 $\frac{72}{81}$
243
396
324
720
648
720
648
72

66
32
28
.2064

1.059484 $\frac{36}{81}$
.000304 $\frac{72}{81}$
1.059789 $\frac{1}{3}$
2127835

.00215
28
1720
430
.06020

.2064
1.06
12384
2064
218784

4.43459
.00215
.225) 10000 (4.43459
9020
9800
9020
7800
6765
10350
9020
13300
11275
20250
20295

1.000000045

3.1415926 5

$\frac{\pi D^2}{4} = \pi R^2$

3

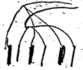
2).0010
.0005
.0005
.00000025

3.1415926 5
.00000025
1570796325
628318530
.0000007853981625 = Area of 1 mil. in sq. in.
12
1570796325 0
785398 1625
.0000094247779500 = Contents of mil.-foot. in cu. in.

1728) .000009424777950 (.000000005 45415
8640
7847
6912
9357
8640
7177
6912
2659
1728
9315
8640
675

.00000000545415 = Contents of mil.-foot in cu. ft.

.00000000545415
555 lbs
2727075
2727075
2727075
.000003027053 25 = weight of mil-foot in lbs.
7000
.021189372750 00



4

97)22550(2
194
3 15
2187

2154
2156
5

75684
153
37052
13920
22764
45684
192 2852

4.5684
6.4
2.5
4.5684
4.5684
274104
2.7.4.5.6.0.2
2.7.4.5.6.0.2

.021159272275)1.000000000000(47.1934687
605779100
1589509000
1193256092.5
409994807.50
211893272.75
198054347.50
190703435.75
7349992750
6356811825
993180925.0
847574870.0
14956060750.0

14.56060150.0
127136236.50
1846997785.00
1692174832.00
1578283000
1483256092.5
35024207.50

47.193469)2255000000000000(.0047782
1887738786
367261240
330354283
36906957.0
33035428.3
3871528.70
3775477.52
96051.180
94386.938
1664242.00
1415804.07
248437.935
235967.345
12469.590

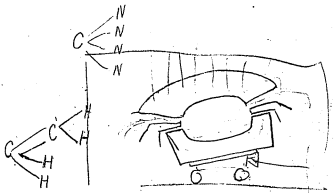
4.7.193469)2255 0000 0000(.004
1887738786

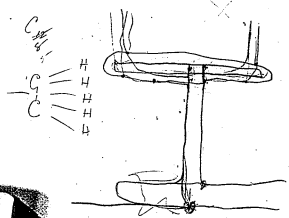
47.193469
2255 7000
235967345
235967345
943386938
943386938
106.42127259.5

1/(1/M) V
.7000
2255.0
2155.0
.03

.2255000000000
.0000322142857

.0211761) 2189990 (10,33
2111761 ×
713908
635283
786170





7

21.284254519 (4.613486
86) 5 28
516
921) 12 42
921
9223) 32854
28869
92264) 4985557
3692656
922688) 79999590
73812804
5680860

10.6421272595 (3.262225
62) 164
124
646) 4027
3876
6522) 195527
130848
65242) 1483335
1304848
652442) 17844495
13048884
4793110

~~3.262~~

212842545 19
3) 21.284254519 (2.1663
7.094747848 4
46) 309
276
526) 3347
3156
5323) 19184
15969
53266) 3215 54
3199596

9) 21.284254519 0
~~4.258850904038~~
~~3.04460777 88~~
2.369917169

2.6605318 1 (1.6311
26) 166
323) 1760
320) 3631
32621) 37681

8

.5,3210636293 4 (2,3067

43) 132
129
4606) 31063
27636
46127) 342742

4.25685090 3 8 (20632137
4

406) 25685
24336
4123) 132589
12369
41262) 856190
825248
412641) 5666635
4128241
4123423) 15399709
12369269
41264267) 30204310
25111111

3.5473757531 7 0 (1.883448

28) 254
224
365) 3073
2919
3763) 12975
11289
37669) 1686675
1506656
376684) 1801956
1706956
3764888) 2957975 70
3016

9

3,0406077880 (1,74373

27) 204
189
3444) 1506
1376
34887) 13087
10999
348867) 2558788
2440669
3488743) 1180980
1046227

2,1364917169 0 (1,337828

25) 136
125
3.63) 1149
989
3067) 29017
21469
30748) 254816
245984
307562) 8832290
6151124
3075645) 26816660
24604184

2,1284254519 (1,45489

24) 112
96
2855) 16594
14275
29088) 2319325
2326464
29169) 2661435
2625221
29178) 362419

10

3.3166) 4.613486

2.2361) 3.26223 (1.458 89

2 2361 ×

102613

89444

131690

111805

198850

178888

19962 8

17888 8

2073 20

2.4495) 3.26223 (1.331794

2 4495 ×

81273

73485

77880

73485

43950

24495

19455 0

17146 5

2308 50

2199 15

109 350

87 6) 10.642212225 95

~~1.773368187 66~~

~~1.5203038956~~

1.330265907 4

2.6458) 3.26223 (1.232298

2 6458 ×

61643

52916

87270

79374

78960

72916

260440

238122

223180

211

86.11

39.92

12403

46.19

3.62

42.57

41.70

2.84284) 3.26223 (1.153483

2 8284 ×

39.92

1.47

43383

28284

150990

141420

95700

84852

108480

84852

236280

226272

100080

84852

11

44.72

3.62

87.10

12

9) 10.642127259 5-
1.182458584 4

3) 3.26223
1.087 41

3.1623) 3.26223 (1.0316
3 1623 x
99930
94869
50610
31623
189870
15 6 3 3

21.284254 5 19
.00003221 43
63852763557
85137018076
3 1 2 8 4 2 5 4 5 1 9
4 2 5 6 8 5 0 9 0 3 8
4 2 5 6 8 5 0 9 0 3 8
63852763557
.000685657360

10.642127259 5 7
.00003221 43 7
31 9 2 6 3 8 1 7 7 8 5
4 2 5 6 8 5 0 9 0 3 8 0
10 6 4 2 1 2 7 2 5 9 5
3 1 2 8 4 2 5 4 5 1 9 0
3 1 2 8 4 2 5 4 5 1 9 0
3 1 9 2 6 3 8 1 7 7 8 5
.00034 2 8 2 8 6 8 5 5

3) .00 1371314
.000457104

1.0316 × 1.0316 = 1.06421 2725595
1.06421 2725595
1.1 2 0 1 4 0 3 6 7 5 2
4 2 5 6 8 5 0 9 0 3 8
5 3 2 0 1 8 9 7 5
2 5 6 8 5 0 9 0 3 8
4 2 5 6 8 5 0 9 0 3 8
4 2 5 6 8 5 0 9 0 3 8
63852753557
.00068567695438658207 83

13

21,284 2 5 4 5 1 9 0
.00003 2 2 1 4 3
42568509038 0
42568509038 0
63852763557 0
685352994

21,284 2 5 4 5 1 9
.00003 2 2 1 4 3
63852763557
85137018076
3 1 2 8 4 2 5 4 5 1 9
4 2 5 6 8 5 0 9 0 3 8
4 2 5 6 8 5 0 9 0 3 8
63852763557
.000685657360

F.4

14): 0006855657 (41832
25
14
116
112
45
82
37
28
50

14): 0006855657 (43975
32 XXXX
125
112
136
128
165
98
77

16): 1006855657 (42853
42 XXXX
125
126
125
57
52
90

18) 0006855657 (38092 15
57 XXXX
145
143
165
162
37

99 ! 100 ! ! .2064

~~1.995635~~
8.004365
2.000000
8.314708
~~7~~.319073

.20848

~~1.98677~~
8.01323
2.000000
7.314078
7.327308

.2 1248

97) 206400 (2127
194 XXX
1270
1194
760

~~1.98677~~ 2559134) 2425-3150 (948
6.01323 2273072
2.00000 1380 1080
7.314709 1143653.6
7.327939 2364 5440

.21278 2559134) 2243 3280 (785
~~1.995635~~ 2001 3938
6.004365 2418 3420
2.000000 2287 3072
7.314709 1320 3480

7.319074 932) 54580 (91
.2084585 920
.2064 932) 7 5520 (842
.0020585 7 4567
3940
3728
2120

.2064
.0062555
.2126555

99) 20.64000 (.2084585
19 8 7 7
8540
7922
4960
3960
8540
7922
980

.2127835
.2064
3) .0063835
.0021278

50) 20.64
50) .4128

14) .0000 6442744 (4.602
56 XXX,00000
84
84
27
28

16) .0000 6442744 (402671
6 XXXX
42
32
107
96
114
112
24

18) 0000 6442744 (35793
54 XXXX 00000
164
90
172
126
137
126
54
54

Distance	Angle of Mere.	1 Chain Reader					2 Chain Reader				
		Distance	Bearing	Magnet. Bearing Left	Magnet. Bearing Right	Corrd.	Distance	Bearing	Magnet. Bearing Left	Magnet. Bearing Right	Corrd.

100 : 97 :: $\frac{1}{.2064}$

97
2064
2127
97
14889
19143
206519

.2255 ($\frac{1}{.021189372 75}$)

$\frac{D}{M}$

.2064 : .2255 :: 9.718

~~3147097~~
~~0~~
10.6852903
1.3531465
0.9875769
.02601 37
10.618

7000) .02189 (.0003
21000

21.284254519
.000003027
14989978163 3
42568509038
638527763557
.00006442743842901 3

3.547375753
7.094751506

21.284254519

7.094751506 (26636

46) 309
276
526) 3347
3156
5323) 19150
15969
53266) 31100
31956

38
42

21.284
.000003027
14989978
42568
638527
.00006442743842901 3

0.80103
0.66903
1.46506
$\bar{5}$.80909
3.20412
$\bar{7}$.01321

0.51357
0.80103
1.31454
~~$\bar{5}$.00799~~
~~3.20412~~
~~$\bar{2}$.28402~~

0.42547
0.80103
1.22650
$\bar{5}$.33203
3.20412
$\bar{2}$.53615

$\bar{5}$.50799
3.20412
$\bar{2}$.71211
0.36299
0.80103
1.16402
$\bar{5}$.20710
3.20412
$\bar{2}$.41122

0.31454
0.80103
1.11557
$\bar{5}$.11025
3.20412
$\bar{2}$.31437

0.27497
0.80103
1.07600
$\bar{5}$.03100
3.20412
$\bar{2}$.23512

0.26748
0.80103
1.01357
$\bar{6}$.90596
3.20412
$\bar{2}$.11008

0.16403
0.80103
0.96506
$\bar{6}$.80909
3.20412
$\bar{2}$.01321

0.12444
0.80103
0.92547
$\bar{6}$.72989
3.20412
$\bar{3}$.93401

22

0,09096
0,80103
0,89199

6,66295
3,20412
3,86707

0,06202
0,80103
0,86305

6,60495
3,20412
3,80910

0,03639
0,80103
0,53742
6,55976
3,20412
3,76388

0,01351
0,80103
0,81454
6,50799
3,20412
3,71211
1,90309

0,66403
0,95155
1,61558
5,80909
3,80618
1,61527

5,20412
5,80909
7,01321
2,505152
5,01030
5,80909
0,81939

10319
64
41276
61914
660416

10319
49
92871
41276
505631

10319
16
61914
10319
165104

10319
36
61914
30957
371484

10319
64
10319
81
103119
825552
83.5839

2,60206
5,20412
5,80909
.01321

10319
64
41276
61914
660416

10319
49
92871
41276
505631

10319
25
51595
20638
257975

10319
49
92871
41276
505631

2,505-15-00
5,80909
2,31424

2,505-15
5,01030
5,80909
0,81939
2,30103
4,60206
5,50409
0,41115

~~0,80618~~

0,95715-45
,5-13.57
1,46505-5-

3,80618
$\bar{5}$,50799
$\bar{1}$,31417

2,55-56302 for 2
5,1 12605
$\bar{5}$,80909
0,92169

0,95715-45
,425-47
1,37701 5-

3,80618
$\bar{5}$,33203
$\bar{1}$,13821

2,778 15-13 2

5,55630 ~~2.5~~ ,00215 .2064
$\bar{5}$,80909 ,2 .0602
1,36539 ~~26~~ ,1720 ~~4.30~~ ,06620
37 57
165

23,1949 . ,21869

2,5772 8 = ,21869.2
20

165) 23,1949 (1 8w = 13,13340
165 w = 1,6417
669

0,95715-45
,36299

3,80618
$\bar{5}$,20710

1,31453 5 $\bar{1}$.01328

0,95715-45
,3145-4

3,80618
$\bar{5}$.11025

1,26608 5 $\bar{2}$,91643

0,95715-45
,27497

3,80618
$\bar{5}$,03100

1,22651 5 $\bar{2}$.83718

0,95715 45
,2248

3,80618
$\bar{6}$,90596

1,16402 5 $\bar{2}$,71214

0,95715 45
,16403

3,80618
$\bar{6}$,80909

1,11557 5 $\bar{2}$,61527

0,95715-45
,12444

3,80618
$\bar{6}$,72989

1,07598 5 $\bar{2}$,53607

0,95715-45
.09096

3,80618
$\bar{5}$,66295

1.04250 5 $\bar{2}$.46913

1772000
1754320
1736740
1719240
1701830
1684510
1667300

~~837470~~
819

17680
17680
17500
17540
17320
17210

843650
819370
2 | 24280
12140

51212
45363
2 | 5849
2924,5
48287,5
48

10506,20
10235,00
2 | 271,20
135,60
10370,60
40

2835520
2695520
2 | 140000
70000
2765520
40
6980

831510
811510
811070
40

708,8
177,2
2 | 886,0
443,4

868280
843650
2 | 24630
12315
12355
8560

4977150
4791500
2 | 186000
93000
4884500
40

8932,00
868280
2 | 24980
12480
8807,80
40

7955450
7720,20
2 | 23430
11715
7837335
40
195,85

708,8
177,2
531,6
2 | 265,8
443,0

0.951545	3.80618
.06202	8.160498
1.013565	$\bar{2}$.41116
0.951545	3.80618
.03639	6.559976
0.987935	$\bar{2}$.36594
0.951545	3.80618
.01351	8.50799
0.965055	$\bar{2}$.31417
2/2.079812	2/1.90309
	.951545
1.039590 6	4.158362 4
.66403	$\bar{5}$.80909
1.703620 6	$\bar{1}$.967452 4
1.039590 6	4.158362 4
.51357	$\bar{5}$.50799
1.553100 6	$\bar{1}$.666352 4
1.039590 6	4.158362 4
.42547	$\bar{5}$.33203
1.465060 6	$\bar{1}$.490392 4
1.039590 6	4.158362 4
.36299	$\bar{5}$.20710
1.402580 6	$\bar{1}$.365462 4

1,0395906	4,15836242
31454	7,11025
1,3541306	7,2686124
1,0395906	4,15836 24
27497	3,03100
1,3145606	7,1893624
1,0395906	4,15836 24
21248	8,90596
1,2520706	7,0643224
1,0395906	4,15836 24
16403	8,80909
1,2036206	2,96745 24
1,0395906	4,15836 24
12444	8,72989
1,16403	2,88825 24
1,0395906	4,15836 24
09096	8,66295
1,13055	2,82131 24
1,0395906	4,15836 24
06202	8,60498
1,10161	2,76334 24
1,0395906	4,15836 24
03639	8,55976
1,07598	2,71812 24
1,0395906	4,15836 24
01351	8,50799
1,05310	2,66635

2.20417

31

1,10206	4,40824
66403	5,80909
1,76609	0,21733
1,10206	4,40824
51351	5,50799
1,61557	7,91623
1,10206	4,40824
42547	5,33203
1,52753	7,74027
1,10206	4,40824
38299	5,20710
1,46505	7,61534
1,10206	4,40824
31454	5,11025
1,41660	7,51849
1,10206	4,40824
27497	5,03100
1,37703	7,43924
1,10206	4,40824
21248	6,95596
1,31454	7,31420
1,10206	4,40824
16403	6,80909
1,26609	7,21733
1,10206	4,40824
12444	6,72989
1,22650	7,13813

30

1,10206	034	4,40824
09096	25	6,66295
1,19302	170	7,07119
	68	
1,10206	.850	4,40824
06202		6,60498
1,16408		7,01322
1,10206		4,40824
03639		5,55476
1,13845		2,96800
1,10206		4,40824
01351		5,50799
1,11557		2,91623
2/2,30103		
1,150515		4,60206
66403		5,80909
1,81454		0,41115
1,150515		4,60206
51351		5,50799
1,66402		0,11005
1,150515		4,60206
42547		5,33203
1,57598		7,93409
1,150515		4,60206
36299		5,20710
1,513505		7,80916

2c
1,3-5
1,3-0
2,3-0

000341

5869560
5934240
2)11803800 =
5901900
5934240
5999280
2)11933520
5966760
5999280
6064680
2)12063960
6031980
6064680
6130400
2)12195080
6097040
6130400
6196520
2)12326920
6163460
6196520
6262960
2)12459480
6229740
6262960
6329760
2)12592720
6296360

5364920
5426760
10791680
5395840
5426760
5488920
2)10915680
5457840
5488920
5551480
2)11040400
5520200
5551480
5614400
2)11165880
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2)11292080
5646040
5677680
5741280
2)11418960
5709480
5741280
5805240
~~36040~~
11546520
5773260
5805240
5869560
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4884680
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2)9826600
4913300
4941920
5004840
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2)10065840
5032920
5061000
5121080
2)10182080
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5211880
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1,1505 15 31454 1,465055	~~1,8~~ 4,60206 1,11025 1,71231
1,150515 27497 1,425485	4,60206 1,03100 1,63306
1,150515 21248	4,60206 6,90596
0,21248 1,362885	6,90596 1,50852
0,16403 1,31454	6,72954 1,33195
0,12444 1,27495	4,66216 6,72989 1,3319
0,09096 1,24147	6,62975 1,26501
06202 1,21253	6,60498 1,20704
03639 1,186905	6,55976 1,16182
01351 1,164025	6,50799 1,11005
66403 1,85413	5,80909 0,5695124
51351 1,70361	5,50799 0,26841
42547 1,61557	5,33203 0,09245

25 21 25 50 — 25 17 175 25 425 — 36 34 144 108 1224 — 175 200 36 324 36 288 16 144 16 128 36 25 225 36 324

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21248
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8,72989
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06202
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03639
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3,5280
1,7640
2,1780

36
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5,11025
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5,03100
7,79142

6,90596
7,66638

6,72989
7,49031

6,72989
7,49031

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6,80909
7,41115

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7,66295
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7,60498
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7,58976
7,34018

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31.416 : 20 : : 10 : 3.1416

31,416 / 200,000 (6.36

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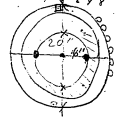

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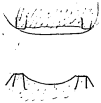

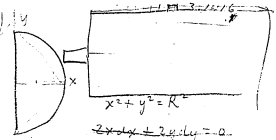

$x^2 + y^2 = R^2$

$\cancel{2xdx + 2ydy = 0.}$

$y = \sqrt{R^2 - x^2}$

$$X_1 = \frac{\int x\sqrt{R^2-x^2}\,dx}{\int \sqrt{R^2-x^2}\,dx}$$

3.1416

60 / 314160

53

3142
2142
6284
12568
31420
9424
9872164

32 / 9872164 / 30 322 / 9872164 / 493.6082

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1.25

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0,03639	$\bar{1}$,55976
1,25996	$\bar{1}$,45407
0,01351	$\bar{1}$,50799
1,23708	$\bar{1}$,40230
0,66403	$\bar{1}$,80909
1,91660	0,81939
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1,76608	0,51829
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1,67804	0,34233
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1,41660	$\bar{1}$,81939
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1,94218125	0,921695
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1,79166	0,62059
42547	$\bar{3},33203$
1,70362	0,044635
36299	$\bar{3},20710$
1,64114	0,319705
31457	$\bar{3},11025$
1,59269	0,22285

27487
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21248
1,49063/25

16403
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$\bar{5}$,50799
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$\bar{5}$,33203
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$\bar{5}$,20710
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$\bar{5}$,11020
0,66655

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243
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1653
$\bar{5}$,03100
0,74360 5
1377

$\bar{5}$,90596
0,01856 65

$\bar{6}$,80909
7,92169

$\bar{6}$,72989
7,84249 5

$\bar{6}$,66298
7,77555

$\bar{6}$,60498
7,71758

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7,67236

$\bar{5}$,50799
7,62059 5

$\bar{5}$,80909
1,01321

5,1949
2,577

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$\bar{5}$,03100
0,98730

$\bar{5}$,90596
0,92276

$\bar{6}$,80909
0,36539

$\bar{6}$,72989
0,28679

r = Resistance at 0°C, or 32°F.

t = temperature Fahrenheit.

$$R = r\left[1 + a\tfrac{5}{9}(t-32) \pm b\left(\tfrac{5}{9}\right)^2(t-32)^2\right].$$

For Copper $a = .003824$ $b = +.00000126$

Then formula is

$$R = r\left[1 + .002124(t-32) + .0000003889(t-32)^2\right].$$

Take as ex 10°C. = 50°F.

$$R = .2654\left(1 + .003824(10) + .0000012\ldots\right)$$

$$R = .2654\left(1 + .002124\ldots + .0000003889(18)^2\right)$$

	06202	$\bar{6}.60498$
	1.36305	7.80910
	03639	$\bar{6}.55976$
	1.33742	7.76388
	01351	$\bar{6}.50799$
	1.31454	7.71211
	66403	$\bar{5}.80909$
	1.985756	1.09
	51351	$\bar{5}.50799$
	1.835236	0.79689
	42547	$\bar{5}.33203$
	1.747196	0.61893
	36299	$\bar{5}.20710$
	1.688716	0.49400
	31454	$\bar{5}.11025$
	1.636266	0.39715
	27497	$\bar{5}.03100$
	1.59669	0.31790
	21248	$\bar{6}.90596$
	1.534206	0.19286
	16403	$\bar{6}.80909$
	1.485756	0.09599
	72444	$\bar{6}.72989$
	1.446166	0.01679
	09096	$\bar{6}.66295$
	1.412816	1.94985
	06202	$\bar{6}.60498$
	1.383746	1.89188

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01351
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8,55976
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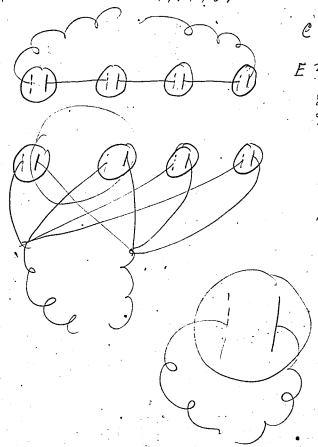
8,50799
7,79489



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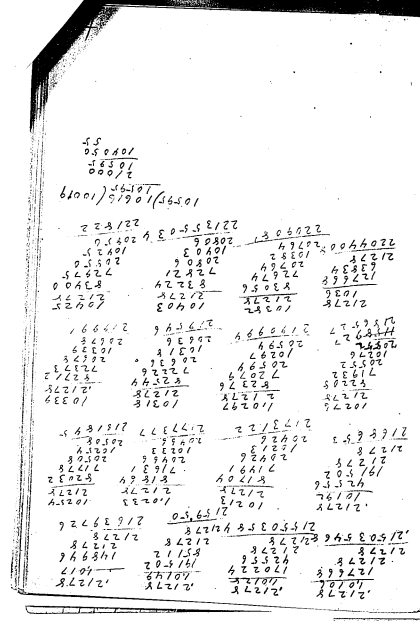
51351	$\bar{3}$, 50799
1,85913	0,87047
42547	$\bar{3}$, 33203
1,76609	0,69451
36299	$\bar{3}$, 20710
1,70361	0,56958
31454	$\bar{3}$, 11025
1,65516	0,47273
27497	$\bar{3}$, 03200
1,61519	0,39345
21248	$\bar{3}$, 90596
1,55310	0,26844
16403	$\bar{3}$, 80909
1,50465	0,17157
12444	$\bar{3}$, 72988
1,46506	0,09237
09086	$\bar{3}$, 66295
1,43158	0,02543
06202	$\bar{3}$, 60498
1,40264	$\bar{3}$, 96746
03639	$\bar{3}$, 55996
1,37701	$\bar{3}$, 92224
01351	$\bar{3}$, 50799
1,35413	$\bar{3}$, 87047



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51354	$\bar{3},50799$
1,87151	0,93999
42547	$\bar{3},33203$
1,78347	0,76403
36299	$\bar{3},20710$
1,72099	0,63710
31454	$\bar{3},11025$
1,67254	0,54225
27497	$\bar{3},03100$
1,63297	0,45300
21248	$\bar{3},90396$
1,57048	0,33796
16403	$\bar{3},80909$
1,52203	0,24109
12444	$\bar{3},72989$
1,48244	0,16189
09096	$\bar{3},62995$
1,44896	0,04995
06202	$\bar{3},60498$
1,42002	0,03698
03639	$\bar{3},55976$
1,39439	7,99176
01357	$\bar{3},50799$
1,37151	7,93999

66403	$\bar{3}.50909$
2.038812	1.305949
51351	$\bar{3}.50799$
1.88760	0.00433
42547	$\bar{3}.33203$
1.77956	0.82839
36299	$\bar{3}.29710$
1.73708	0.72346
31454	$\bar{3}.11025$
1.68863	0.86161
27497	$\bar{3}.03200$
1.64906	0.72736
21248	$\bar{3}.95596$
1.58657	0.40232
16403	$\bar{3}.80909$
1.53812	0.30595
12444	$\bar{3}.72989$
1.49853	0.22625
09096	$\bar{3}.66293$
1.46500	0.11593
06202	$\bar{3}.60498$
1.4361	0.1013
03639	$\bar{3}.55976$
1.4104	0.0561
01354	$\bar{3}.50799$
1.3876	0.0343

2,748188
1,37404
,66403
2,038

6640.3
2,0531

51351
1,90258

8,42547
1,81454

,36394
1,75206

31454
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16403
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12444
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1,40258

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1 Ohm

a - 2 - 3

a-3 3-2 2-1

a -2b +c

b-2c+d

1.4142 = √2

1.4142
.1065
7 6 7 1
84 852
.591 8236

6.598
26.392

2.204
2.784
11.136
3.437
13.748
4.159
16.636
4.949
19.796
5.808
23.232
6.736
26.944
7.733
30.932

3.298
13.192
4.174
16.696
5.154
20.616
6.236
24.944
7.421
29.684
8.710
34.840
10.101
40.404
11.596
46.384

1.6500
5.500
2.088
8.352
2.575
10.312
3.119
12.476
3.712
14.848
4.356
17.424
5.052
20.208
5.800
23.200

.00983
600
5.898000

1.4142
1577
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1 5 8 8 9 9
1 5 8 8 9 9 4

8.35
33.40
10.309
41.236
12.473
49.892
14.845
59.380
17.421
69.684
20.205
80.820
23.195
92.780

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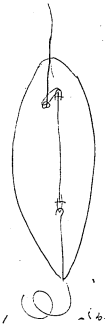
3 6 7 5 6 0
3 6 6 3 0
3 1 3 0 5 0



1,320	1,101	1,826
5,280	4,404	3,652
1,671	1,392	1,044
6,684	5,568	4,176
2,062	1,718	1,289
8,248	6,872	5,156
2,496	2,079	1,559
9,984	8,316	6,236
2,970	2,475	1,855
11,880	9,900	7,420
3,484	2,904	2,178
13,936	11,616	8,712
4,042	3,368	2,525
16,168	13,472	10,100
4,640	3,866	2,899
18,560	15,464	11,596
,660	,550	,471
2,640	2,200	1,884
,835	,696	,596
3,340	2,784	2,384
1,039	,859	,736
4,156	3,436	2,944
1,247	1,039	1,891
4,988	4,156	3,564
1,485	1,237	1,060
5,940	4,948	4,240
1,742	1,452	1,244
6,968	5,808	4,976
2,021	1,684	1,443
8,084	6,736	5,772
2,320	1,933	1,657
9,280	7,732	6,628

$R \propto \frac{L}{m}$

$R = 10.642 \frac{L}{m}$.

$m = \frac{10.642 L}{R}$

$L = 2.0 \mu$

$R = 2.0 \text{ ohm}$

$m = \frac{10.642 \times 2.0}{2}$

$m = 10.642 \text{ ohm}$

4436

10/10.642

10.6642
4436
63852
31922
42565
4720.7772 / 68.78
36
1287/1220
1287/9678
13677/3569
13748/7112

.06878

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46315
3235
43083
3413
37670
3774
3106

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3770
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3672

.372
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.470
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2.512

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.117
1.448
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2.515
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5555624) 5.68 ÷ 0.000 (0.000102
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70710
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.065
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5.658000

.000158
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5.68 × [illegible]
36000 × [illegible]

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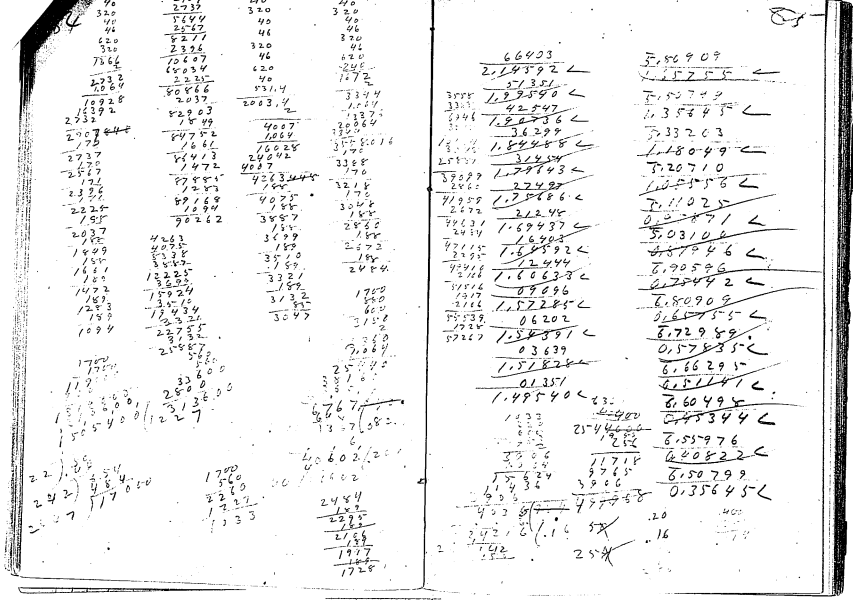

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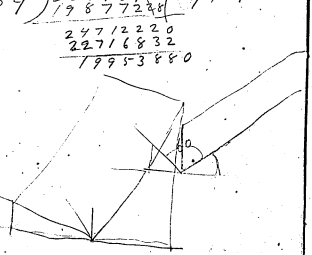

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1.585854
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1.597007

1.60206
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1.607742
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1.612093

1.61261
01351
1.62616

1.61776
01351
1.62127

1.62273
01351
1.62626

1.62763
01351
1.64114

3.120573 9
~~1.560286~~
6.241147 8
5.80909
2.05502 378
050 22250
~~928~~

3.133538 2
6.267077 8
5.80909
2.076168
1650
9

200.
29.04
172.96
2.53
1.71
.07
175.27

33.5500
13.83
26400 0
9900 0
33 000
110.00
456500 00

63.2
8.31
71.55

45.6500
7.7833) 2 84160 (6
273802
1056 00
45 65 00

2859134) 24161470 (84.5
2287307 2
1285 3788
1142 5336
1427 44 40

122

27,15
1550
2172200
27172
2715
1,2942
1,0729
357294
459378
150284
357294
57172
7776653 4

2830550
1634
2859134

994,2
771,75
322,45
111,225
13,5
189,00
53367
1225
37975
1538,6 ~~125~~
122
30772
17702
15386
2646398
1172397
1552473
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552722
1852973
268639
2537977,0783

2859134)2234545370(78,2
2001939 8
2334545120
2287307 2
472208480
285913 8
1861 3 4 6

2859730)2451 1620(84
2319784 0
131378800
115986920
15388800

6,7309760
5,50799
2,2389660
79,82
171

6,7745 8240
5,50799
~~2,2538490~~
79,82
158
6,7604224
5,50799
2,2689424
8 907
217

1,6324089	3,2648178	6,5329635 6 / 5,50799 / 2,0276256
1,6370789	3,2741578	6,5483156 / 5,50799 / ~~2,0433056~~
1,6416506	3,2833012	6,5666024 / 5,50799 / 2,0245924
1,6461285	3,2922561	6,5845122 / 5,50799 / 2,0225022
1,6505150	3,3010300	106 / 334 / 79 / 6,6020600 / 5,50799 / 2,1005500
1,6548151	3,3096302	404 / 346 / 6,6192604 / 5,50799 / 2,1292504
1,6590317	3,3180633	160 / 6,6361264 / 5,50799 / ~~2,1461764~~
1,6631680	3,3263359	146 / 576 / 96 / 6,6526718 / 5,50799 / ~~2,1626718~~
1,6672269	3,3344538	615 / 543 / 78 / 6,6689076 / 5,50799 / ~~2,1789276~~
1,6712114	3,3424227	976 / 723 / 253 / 6,6848454 / 5,50799 / ~~2,1948354~~
1,6751240	3,3502480	354 / 183 / 171 / 6,7004960 / 5,50799 / ~~2,2104860~~
1,6789674	3,3579348	860 / 682 / 178 / 6,7158696 / 5,50799 / ~~2,2258596~~
1,6827440	3,3654880	6,7309760
1,6864560	3,3729120	6,7458240
1,6901056	3,3802112	6,7604224

12X 93.2

2.83 9500
93.2
5679000
8518500
2555550
264641.4
19634
264641.4) 2416 2666048

2666048) 2416 1470 (90.6 %
2399443.2
1670380.6
1599628

2666048) 2234 445 (83.8 %
2132838
1020960
799104
2202516

1.079
76
6474
1078
17264
745
86320
69056
17264
168) 2503.288 (14.90
168
823
672
1512
1512

993
656
2336
167
150
1750
1505
1050
1050
2635266
1022297
1444682
2371737
5270522
2864652
2835536
28275549

109.050 — 1.63241 / 66403 / 2.29644
113.843 — 1.63708 / 66403 / 2.30111
118.739 — 1.64165 / 66403 / 2.30568
123.732 — 1.64613 / 66403 / 2.31016
128.840 — 1.65052 / 66403 / 2.31455
134.045 — 1.65482 / 66403 / 2.31885
139.353 — 1.65903 / 66403 / 2.32306
145.433 — 1.66317 / 66403 / 2.32720
150.279 — 1.66723 / 66403 / 2.33126
155.896 — 1.67121 / 66403 / 2.33524
161.617 — 1.67512 / 66403 / 2.33915
167.440 — 1.67897 / 66403 / 2.34300
173.367 — 1.68274 / 66403 / 2.34677
179.397 — 1.68646 / 66403 / 2.35049
185.529 — 1.68011 / 66403 / 2.35414

125

84.8
93.2) 7845.0 (90.9%
7383
920
93.2) 7845.0 (84.2
7367
3900
3728
1720
9200
5586
3120

12p

	Pages 57	58	59
1.63241	1.63241	1.63241	
1.99540	1.99695	1.90735	
1.63708	1.63708	1.63708	
2.00267	1.99762	1.92205	
1.64165	1.64165	1.64165	
2.00466	1.99819	1.91462	
1.64613	1.64613	1.64613	
2.00772	1.98067	1.92110	
1.65052	1.65052	1.65052	
2.01351	1.97566	1.92549	
1.65482	1.65482	1.65482	
2.01981	1.96936	1.92979	
1.65903	1.65903	1.65903	
2.02292	1.97257	1.93400	
1.66317	1.66317	1.66317	
2.02846	1.97971	1.93814	
1.66723	1.66723	1.66723	
2.03622	1.98277	1.94220	
1.67121	1.67121	1.67121	
2.03420	1.98225	1.94618	
1.67512	1.67512	1.67512	
2.03811	1.98966	1.95009	
1.67897	1.67897	1.67897	
2.04196	1.99351	1.95394	
1.68274	1.68274	1.68274	
2.04573	1.98728	1.95771	
1.68646	1.68646	1.68646	
2.07945	2.00200	1.96143	
1.69011	1.69011	1.69011	
2.05310	2.00465	1.96508	

2/2

Page 59. 35 mm

1.63241	1.68274	1.63241	12
5-1351	5-1351	42547	
2.14592	2.17625	2.05788	1.68274
1.63708	1.68646	1.63708	42547
5-1351	5-1351	42547	2.10821
2.15059	2.17997	2.06255	1.68646
1.64165	1.69011	1.64165	42547
5-1351	5-1351	42547	2.11193
2.15516	2.20362	2.06712	1.69011
1.64613		1.64613	42547
5-1351		42547	2.11558
2.15964		2.07160	
1.65052		1.65052	
5-1351		42547	
2.16407		2.07599	.0013
1.65482		1.65482	.0026
5-1351		42547	.0039
2.16833		2.08029	
1.65903		1.65903	.0052
5-1351		42547	
2.17254		2.08450	.0065
1.66317		1.66317	.0078
5-1351		42547	
2.17668		2.08864	.0090
1.66723		1.66723	.0103
5-1351		42547	
2.18074		2.09270	.0116
1.67121		1.67121	.0129
5-1351		42547	
2.18472		2.09668	.0142
1.67512		1.67512	.0155
5-1351		42547	
2.18863		2.10059	.0168
1.67897		1.67897	.0180
5-1351		42547	
2.19248		2.10444	.0193

Page 56

Page 56

1/2

128

14301
14301
19901
134189
88609
16901
222 ~~03 9901~~

223 2/2
1995
6813
99990
15984
15984
1768 2.30

1.47 | 16609 3.80 | 72180
1029 x
319
288
253
1015
1026

175.27
732
38059
12269
122689
1353084.44
1617

2971.56
8 1 8 165
13 5 3 6 5
22 5 9 6 4 3 6

2257.232
1
101.5 ÷ 5 | 1.007
1
2007 | 1.5500
1.0049

169.6
156.9
78.7

14.3
5 | 130.8
26 5/10
3.5
5

1.4914 ~~117~~
2.3026
89484
29828
14742
9828
1131497 64

8388.5
2.3026
503310
167770
25165 5
167770
19315360 10

17.3
5 | 15.5 3/10
31 3/10
2.2
3
6

18.6
5 | 17.2 1/2
32 1/2
32
64

2.13
1.8 9/5
100

14.2
5 | 132 3/10
26 2/10
3.5
12.8

1.5
3.5
5
14

5 | 114 3/10
22 4/10
3.2
5.4

15.5
5 | 139.8
27 1/2
32
139

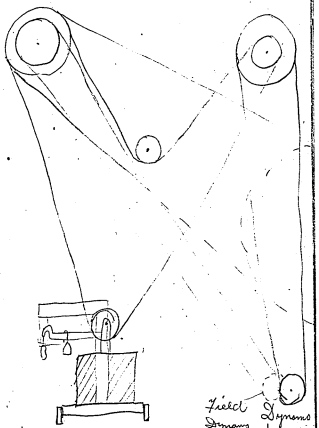
7
3.9
5

5 | 136 1/2
23 1/2
3.7
5

5 | 18.8 1/5
3.8
5.8

129

April 15th 1888.
Sketch of pulleys and belts in dynamo room.



130

201.06
60
12063.60
73
36190.8
10063.6
15582.06
77
1977876
1977876
12075.636

196.15
60
11769.0
3
35307
1789
15297
77
122397.6

D .111 = 10.642L / R = .1646

1.0642
1600
63.852
1.0642
60.
63.8520

1915.56
1854.704
3767.260
7453.856
555.129
7539.000
7278.128
7660.152
5939.280
15962.3
15355.580
15332.944
12068.028
16685.556
15536.624
19041.744
14944.368
13960.892
16252.260
9277.040
17559.320
14731.988
18772.988
14942.336
19921.824

1149.336
63.852
1085.484
63.852
1021.632
63.852
957.780
63.852
893.928
63.852
830.076
63.852
766.224
63.852
702.372
63.852
638.520
63.852
574.668
63.852
510.816
63.852
446.964
63.852
383.112
63.852
319.260
63.852
255.408
63.852
191.556
63.852
127.704
63.852
63.852

19921.824
1085.484
18836.340
18836.340
22328.190
957.780
22386.720
893.928
23480.648
830.076
24710.724
766.224
25476.948
702.372
26179.320
638.520
26817.840
574.668
27392.508
510.816
27903.324
446.964
28350.288
383.112
28733.400
319.260
29052.660
255.408
29307.068
191.556
29498.624
127.704
30127.328
63.852
30191.180

3832 = 10.642×60
R

R = 10.642
60.
3832) 638.520 (.166
3832
2558
2298
2540
332

$R = \frac{10,642\,L}{m}$

30191.18
60352.36

10.642
120
2132.840
10.642
1277.04 × 2
2554.08

1277.04	log	3. 1061909	
1277.04		4. 7505255	
		5. 3252838	.021149
2554.08	log	3. 4072209	
1277.04		4. 7798859	
3831.12	log	3. 5583235	
1277.04		4. 7585713	
5108.16	log	3. 7082679	
1277.04		4. 7753628	
6385.20	log	3. 8051745	
1277.04		4. 7716316	
7662.24	log	3. 8843535	
1277.04		4. 7667034	
8939.28	log	3. 9513035	
1277.04		4. 7535831	
10216.32	log	4. 0092964	
1277.04		4. 7466809	
11493.36	log	4. 0604334	
1277.04		4. 7386696	
12770.40	log	4. 1061909	
1277.04		4. 7294564	
14047.44	log	4. 1475836	
1277.04		4. 7189530	
15324.48	log	4. 1853721	
1277.04		4. 7071783	
16601.52	log	4. 2201604	
1277.04		4. 6932203	
17878.56	log	4. 2523432	
1277.04		4. 6790875	

19155.60 log 4. 282 2 3 048
1277.04 4. 662 5 1 2 3

20432.64 log 4. 310 3 3 2 1
1277.04 4. 644 0 2 4 8

21709.68 log 4. 336 6 5 9 8
1277.04 4. 623 3 9 4 0

22986.72 log 4. 361 4 5 2 3
1277.04 4. 600 3 6 2 9

24263.76 log 4. 384 9 6 2 4
1277.04 4. 574 5 4 0 5

25540.80 log 4. 4072379
1277.04 4. 545 5 2 9 8

26817.84 log 4. 4284264
1277.04 4. 512 7 3 7 7

28094.88 log 4. 4486290
1277.04 4. 475 4 0 9 7

29371.92 log 4. 4679335
1277.04 4. 432 5 5 2 4

30648.96 log 4. 4564163
1277.04 4. 382 6 6 5 3

31926.00 log 4. 5041445
1277.04 4. 3237058

33203.04 log 4. 5211773
1277.04 4. 252 3 1 5 9

34480.08 log 4. 5375673
1277.04 4. 113 1 0 1 7

0215
0216
.6431
.0216
.0647
.0215
.6865
.0220
.7085
.0222
.7307
.0225
.7532
.0229
.7761
.0233
.7994
.0237
.8231
.0242
.8473
.0247
.8720
.0251
.8971
.0257
.9228
.0262
.9490

35757.12 log 4. 553 3 6 2 1
1277.04 4. 095 5 7 1 4

37034.16 log 4. 5686006
1277.04 3. 5770256

38311.20 log 4. 5833235
1277.04 3. 5834255

465) 19.5555 (.0218
3905
850
2350
2340
2340

464) 10.0000 (.215
928
720
560
3520
3240
2400

461) 19.5555 (.0216
3910
760
4.12
2950
2772
1.78

459) 10.0000 (.217
918
820
1020
3410
3213
197

455) 10.0000 (.220
9100
900
10.00
9100
900

458) 10.0000 (.222
916
1000
1000

444) 10.0000 (.225
888
1120
888
2320

437) 10.0000 (.229
874
1260
1048
2120
1748
3850
3496

429) 10.0000 (.233
858
1420
1287
1330

420) 10.0000 (.238
840
1600
1428
3490
3360
130

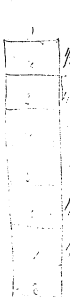
418) 10.0000 (.244
836
180
164
160

398) 10.0000 (.251
796
2020
1990
2250

387) 10.0000 (.258
774
2260
2064
1960
1935
2550
2322
2280
154

374) 10.0000 (.267
748
2520
2244
2760
2618
142

136



$1/10 = R'$

$1/9 = R''$ $\frac{1}{19}$

$\frac{1}{27}$

$\frac{1}{35}$

$\frac{1}{40}$

$\frac{1}{45}$

$\frac{10}{465}$

465)10.0000(.021510
930
700
465
2350
1395
955

13)

$$\frac{1}{R} = \frac{1}{R'} + \frac{1}{R''}$$

$$R = \frac{R'R''}{R' + R''}$$

$$R = \frac{\frac{1}{10} \times \frac{1}{9}}{\frac{1}{10} + \frac{1}{9}} = \frac{1}{19}$$

465
93
465
465
462
3
455
9
455
5
450
5
445
7
437
8
429
9
420
10
410
3577
14
387
23
377
14
360
15
345
16
329

329
12
312
28
284
19
275
20
255
21
234
22
212
23
189
24
165
25
140
26
114
27
87
28
59
29
30

1.32552 / .02257
.3530
.0290
.3820
.0364
.4124
.03321
.44445
.0340
.47785
.0364
.51149
.03392
.5541
.0427
.59665
.0471
.64139
.0329
.6768
.0606
.7574
.0714
.8288
.0877
.9165
.1149
1.0314
.1685
1.2000
.3333
1.5342

314) 10.0000 (.278
2357
250
252
280
258

345) 10.0000 (.289
690×
3100
2760
3400
3105
295

329) 10.0000 (.304
587×
1300
1172

312) 10.0000 (.3205
936×
640
624
1600

294) 10.0000 (.340
825×
1750
1176
40

275) 10.0000 (.365
825×
1750
1650
1000
1122

255) 10.0000 (.392
765×
2350
2295
550
715

234) 10.0000 (.427
936×
640
468
1720
1638

212) 10.0000 (.471
848
1520
1696
360

189) 10.0000 (.529
945×
550
378
1720
1701

165) 10.0000 (.606
990×
1000
990

144) 10.0000 (.714
756×
2600
2520
80

114) 10.0000 (.877
913×
3700
3195
820
795
25
22

87) 10.0000 (.1149
87×
130
87
430
348
820
783
37

59) 10.0000 (.1695
59×
410
354
560
531
290
295
5

30) 10.0000 (.33377
90
100

$\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{5}$

$100\frac{10}{30}$, 100, $\frac{10}{39}$

$\frac{3000}{30}$, $\frac{3000}{30}$, $\frac{10}{39}$

$\frac{20}{3010} + \frac{1}{100} + \frac{50}{10}$

3000
300
301
3010.1775500
301.1775500
17811.91
30100) 178191 (
3010
3775
3010
7650
6020
1630
1505
125
30100) 30100 (
50
601

$100\frac{10}{30} = \frac{3010}{30}$, 100 ∴ $\frac{20}{3010} + \frac{1}{100} = \frac{300}{30100} = \frac{301}{30100}$

Conv. = $\frac{601}{30100}$, R = 601) 30100 (50.1
50

601) 50.0000 (.08332
4808
1920
1803
1170
502527, 100 ∴ $\frac{10000}{502527} + \frac{1}{100} = \frac{1000000 + 502527}{50252700}$

50.0000
2527

1000000
502527
15.02527) 50.0000 (32.44555
.1149
.5264
5025270
5777890
4525270
6693000
6021810
6829820
6010105
5171520
7512635
6544850

140 $\frac{335604}{10000}$ :: $\frac{10000}{335604} + \frac{1}{100} = \frac{1000000 + 33560400}{33560400}$

33560400

13335604) 33560400 (25.12755
26712416 x 0577
6848520 2752
6478020
17030800
13331604
3699196
2671205
1027991 20
7399225
6782920

$25\frac{3152}{10000}$ :: $\frac{10000}{25321152} + \frac{1}{100} = \frac{1000000 + 2532115200}{2532115200}$

12521152) 25321152 00 (20.1375
25042304 x 0714
1721600
12521152 20,2089
4697448
3256952
9380240
8765064
615176 20
5010468
1043752

$20\frac{2089}{10000}$ :: $\frac{10000}{202089} + \frac{1}{100} = \frac{1000000 + 20208900}{20208900}$

1202089) 20208900 (16.8115
12020890 x 0602
8185010
7212534
9728476
9618712
3969620
1386960
1202089
1783910
1202089
581821 20
500835 20
100985 4

$\frac{10000}{15721} + \frac{1}{100} = \frac{1000000 + 1572100}{1572100}$

1168721) 16572100 (14.1364
11685721 x 0524
4886380
4674884
2110960
1007884
9251760
3506163
7455970
7012326
4431640
3506163
9362700

$\frac{10000}{14,4893} + \frac{1}{100} = \frac{1000000 + 1448930}{1448930}$

1144893) 14489300 (12.6556
11448931 x 0471 7027
3040369
2290786
7505840
6293358
6364820
5724465
6403550
5724465
6790850
6124465
6663850
5724465
9391850
8015930
1376000

$\frac{10000}{127027} + \frac{1}{100} = \frac{1000000 + 12702700}{12702700}$

1127027) 12702700 (11.2740
11270271 x 0427 3137
1432430
1127027
3054030
2254054
7990760
7887189
1103710 00
1014324 3
9138570

1X

$$\frac{10000}{113137} + \frac{1}{100} = \frac{1000000 + 113137}{11313700}$$

```
1113137) 11313700 (10.1638
         11131370
          1823300     0392
          1113137     2030
           7101630
           6678822
           4228080
           3339411
            8886690
```

$$\frac{10000}{102030} + \frac{1}{100} = \frac{1000000 + 102030}{10203000}$$

```
1102030) 10203000 (9.2548
         9918270     0364
          2847300
          2204060     2948
           6432400
           5510100
            9222300
            8816240
             4062600
             3306080
              756520
```

$$\frac{10000}{92948} + \frac{1}{100} = \frac{1000000 + 9.2948}{9294800}$$

```
1092948) 9294800 (8.5043
         8739584     0340
          5512160
          5464740
           4742000
           4371792
            3702080
            3278844
             4232360
```

8.5043
.0340
8.5383

$$\frac{10000}{85364} + \frac{1}{100} = \frac{1000000 + 85364}{8536400}$$

1X

```
1055304) 8536400 (7.8650
         7597544
          9388520
          9527120
           7956080
           6327584
           5639960
           5268220
            1214000
```

$$\frac{10000}{85383} + \frac{1}{100} = \frac{1000000 + 85383}{8538300}$$

```
1085383) 8538300 (7.8668
         7597651     3321
          9406190
          9530647 8987
          7231760
          6512298
           7189620
           6512985
           6773220
           6512220
            682200
```

$$\frac{10000}{78987} + \frac{1}{100} = \frac{1000000 + 78987}{7898700}$$

```
1078987) 7898700 (7.3205
         7552908     0304
          3457919
          3236961     3509
           2209970
           2157904
            5191600
            3775948
             1415520
```

14

428.8 — 48°$\frac{1}{5}$ — mercury, and vion.

428. — 54°$\frac{43}{50}$ — Water.

427.7 — 57°$\frac{1}{5}$ — Water.

427.5 — 58°$\frac{1}{10}$ — Water.

427.6 — 59°$\frac{23}{50}$ — Water.

427.4 — 59° — Water.

426. — 59°$\frac{1}{2}$ — Water.

426.3 — 63°$\frac{7}{50}$ — Water.

426.7 — 65°$\frac{12}{25}$ — Water.

Remark upon the first test by Profs. Brackett and Young

15

$\frac{10000}{73509} + \frac{1}{100} = \frac{1000000}{73509} + 73509$

73509.50

10735 09) 73509000 (6.84975
64410354
9098646 0
6588072 0
5710388 0
9294036
8098440
7574563
5838770
5367535
4722250

$\frac{10000}{68764} + \frac{1}{100} = \frac{1000000}{68764} + 68764$

58764.00

10687 64) 6876400 (6.4340
6412584
4638160
4275056
3631040
3206292
4247480
3206292
1041188 0
961887 6
7930040

$\frac{10000}{64618} + \frac{1}{100} = \frac{1000000}{64618} + 64618$

64618.00

10646 18) 6461800 (6.0696
6387708
7409200
6387708
1021592 0
9581562
6343580

146

	27.	1.4314
	27.	1.4314
	44.3	1.6464
dmp	2.22	9.6538
	144	4.1628
	33000	4.5185
		.6443

44.1

~~144~~

	40	1.6021
1.44	1.44	0.1584
.74		1.4437
2.18	40	1.6021
	2.18	0.3385
	18.4	1.2636

14

70.400)	4.8476
2.18	0.3385
32300	4.5091

24.7	1.3927
24.7	1.3927
1.44	0.1584
44.3	1.6464
	4.5902
	4.5185
	.0717

1.17

1.44
.74
.70

44.3
44.28

.7 ~~70.4000~~
106571

1.44
.74

48000
24000
14000
34000

86.1 1.9350
86.1 1.9350
Comp 1.345 9.8715
443 1.6464
244.000 5.3879
7.41 4.5185
.8694

84.4 1.9263
84.4 1.9263
comp 2.62 9.5817
44.3 1.6464
5.0807
4.5185
3.65 .56.22

44.3
60

.21
.28

5.77 : 5.51 :: 7.7

7.7	0.8865
5.51	0.7412
5.77	9.2388
	.8665

7.35

2.106
2.81

2.81
33000

2.51
33000
843
843
9.27 30.00 .21
92

.28
.32
84
84
9.240.00 (44
84
.84

44000 ft. lbs.

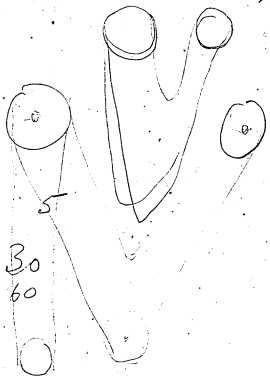
5.51
44 000
2204000
2204
242.4 ~~40000~~ | 7.34
33000
241
1144
99
154

7.34 H.P.

1/4 Ohm

33000

12
144
44
576
576
6336



15 × √(6.1007 − 4.55539 / 396944) + .00001184

6.1007
4.55539 .000000

396944) 1.54668200000 (3.89
1190832
35585850
31755552
3829298
3572496
2687840
2387664
2061760

.00006359
.00001184
.00007543) 3.68 (.003967

69) 673
621
786) 5265
4716
7877) 5530
5313

.003967
0.03441
.005526) 1.000000 (1901.14
5526
4748
4737
600
526
740
526
2140
1852
2800

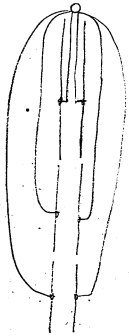
1750 feet Entrance from the central Station.

2,30255
1.97772236
69077255
46051700
16118095
16118095
16118095
20723265
23025585
453872

Statement No 1

39694

59673
59725
48



156

1750 feet Each way from station.

300 Lamps 100 ohms Each

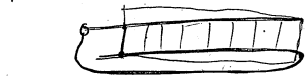
1750 feet each way from Station.

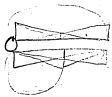
Statement No 2

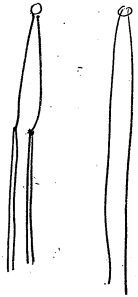
300 Lamps. 100 ohm

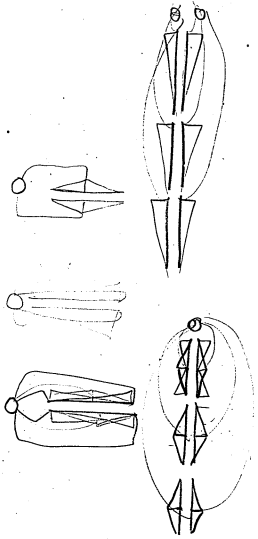
R – 100 on section.

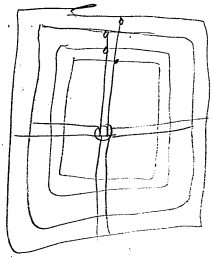
6 sections also.











162) 443000.0000 (12339.5

3.5902

3.5902) 100.00000 (27.85

27.85
44.3
8355
11140
11140
1233.755
1.2.55
1110379 5
9570040
24675 10
12337 55
1536.1015

$$\frac{44.3 \times E^2}{R} = W$$

$$\frac{E}{R} = \frac{W}{44.3\,E}$$

$$C = \frac{W}{44.3\,E}$$

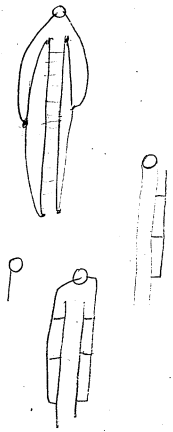
$$W = 44.3\,E\,C$$

3.5902
3.5902
71804
32315
39510
10770 6
125839 3 6 0 4

$\therefore \frac{E}{R} = C$

27.85
27.85
13925
22280
19495
5570
775.6 225

$\therefore$ 775.6 :: 443000



164 Trial of Rotary Engine,
Engineering Jan. 1, 1875.

Every five minutes record was taken of following quantities.

Pressure of Steam by Gauge.
Pressure of Exhaust by Gauge.
Revolutions of Engine by Speed Indicator.
Reading of Brake Scale in lbs.
Temp. of Injection Water } Exhaust-
Temp. of Discharge Water } Steam Tank.

Exhaust-Steam Tank, of iron 4 ft diam. 6 ft. high, Pipe at bottom formed into a cross and perforated with small holes the aggregate area of which was greater than that of pipe.

Steam gauge was attached to steam pipe just within the throttle and also steam and vacuum gauges on the exhaust.

Water in tank was kept at constant height of 70 inches.

Loss by radiation and evaporation in tank was found by heating the water in it to a certain temp.

165 and the rate of loss ascertained. (I would find it by allowing water at constant temperature to flow through. The proper mode during the experiment, if there be abundance of water, would be to allow water to pass in such a quantity that the temperature in outflow would be as much above the atmosphere as the inflow is below the atmosphere).

The rate of flow must be known. Temp. of air should also be observed.

P=

$\frac{10000}{60963} + \frac{1}{100} = \frac{1000000 + 609.63}{6096300.}$

106096.3) 6096300 (57.460
32.48155
7914855.0
7426741 57718
4881090
1243852
63723.80
6367.78
60200

$\frac{10000}{57718} + \frac{1}{100} = \frac{1000000 + 577.18}{5771800}$

105771.8) 5771800 (54.5468
5285590
4832100
4230872
601228.0
528559.0
72369.00
63463.08
8905920
7461744
1441760

$\frac{10000}{54819} + \frac{1}{100} = \frac{1000000 + 548.19}{5481900}$

1054819) 5481900 (5.1970
5274095
207805.0
105481.9
102323.10
94833.71
7489390
7383733
565700

$\frac{10000}{52214} + \frac{1}{100} = \frac{1000000 + 522.14}{5221400}$

105221.4) 5221400 (4.96223
4208856
1012544.0 4.9861
846926
655570
631354
24160.60
21069.28
3141320

$\frac{10000}{49861} + \frac{1}{100} = \frac{1000000 + 498.61}{4986100}$

1049861) 4986100 (4.7493
4198444
787656.0
739027
51755.30
41994.44
9761.60
8398.79
1362.10

$\frac{10000}{47726} + \frac{1}{100} = \frac{1000000 + 477.26}{4772600}$

1047726) 4772600 (4.55552
4190904
582696.0
523863.0 4.5781
57833.00
52386.30
5446.700
5238.630
2108.700

$$\frac{10000}{45781} + \frac{1}{100} = \frac{1000000 + 45781}{4578100}$$

```
10 45781) 4578100 (4.3777
          4583124
           39499760
           31373343
            8126417 0
            7320467
             5037030
             7320467
              7165630
              6546540
               619090
```

$$\frac{10000}{44002} + \frac{1}{100} = \frac{1000000 + 44002}{4400200}$$

```
10 44002) 4400200 (4.2147
          4176008
           224192 0
           2850092 (4.2359
           1533916
           1047028
            4951580
            4176005
             775720
             330614
              44906
```

$$\frac{10000}{42369} + \frac{1}{100} = \frac{1000000 + 42369}{4236900}$$

```
10 42369) 4236900 (4.0647
          4167716
           67420 0 0
           6354214 (4.0867
           4881860
           1165476
           1123840
```


$$\frac{10000}{40867} + \frac{1}{100} = \frac{1000000 + 40867}{4086700}$$

```
10 40867) 4086700 (3.9262
          3122601
           964099 0 (3.9480
           936780 3
            27319 7 0
            20817 3 4
             6501360
             6245202
              2561580
              2081734
               479846 0
```

$$\frac{10000}{39480} + \frac{1}{100} = \frac{1000000 + 39480}{3948000}$$

```
10 39480) 3948000 (3.7981
          3158400
           7896000
           7276360
            1019400
            1035320
             83708 0
             83158 0
              5496000
```

$$\frac{10000}{38197} + \frac{1}{100} = \frac{1000000 + 38197}{3819700}$$

```
10 38197) 3819700 (3.6797
          3114391
           705309 0
           622918 2
            82190 8 0
            72673 7 8
             9517 0 1 0
             6365 7 6
              1151 4 3 4
              9343 7 7 3
               1732 3 7 0
               1038 1 9 7
```

170

$$\frac{10000}{37008} + \frac{1}{100} = \frac{1000000 + 37008}{3700800}$$

10 37008) 3700 5000 (3.15687
3 111 0 24
0 2 15
5 5 9 7 7 6 0 0
5 1 5 5 0 4 0 3, 5 9 0 2
7 1 2 2 2 0 0
6 3 2 2 0 4 4
9 0 5 7 1 5 2 0
5 2 7 6 0 6 4
7 5 5 4 1 5 6 0
7 2 5 9 0 5 6
2 9 5 5 0 4 0

3.7008) 359.0200 (97.0114
333 0 72 X
2 5 9 4 8 0
~~2 7 3 0 4 4~~
~~3 2 4 3 2 0~~
2 5 9 0 5 6
6 2 4 0 0 0
3 7 0 0 8
5 3 9 2 0
3 7 0 0 8
1 6 9 1 2 0
1 4 8 0 3 2
1 0 8 8 8

3.85197) 359.0200 (96.7
3 4 5 7 6 X
~~5 3 4 4 4 0~~
~~3 3 5 0 7 2~~
2 5 8 1 8 0
~~2 5 9 1 8 2~~
~~2 0 6 7 8 0~~
~~1 0 5 3 8 0~~
~~1 7 4 4 4~~

171

a , b , c , d
x y z , t

$z : a :: x : y$

$y = \frac{ax}{z}$

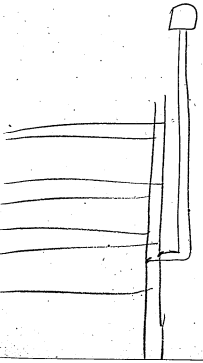
$c : z :: y : z$

$z = \frac{zy}{c} = \frac{axy}{zc}$

$d : c :: z : t$

$t = \frac{cz}{d}$

$t = \frac{axy}{zd}$



172

3.8197) 359.0200 (93.9917
343773×
152470
147391
378790
343773
350170
343773
63970
38197
25773
23739

3.9480) 359.0200 (90.9372
~~355.3200×~~
~~43.1800~~
355320
370000
355320
14680
11840
2840
2560
2400

4.0567) 359.0200 (87.8508
326936×
329840
280069
347710
326936
20774
20433
3400
3269
1356

4.2369) 359.0200 (84.7365173
238952×
120068
169476
312040
296583
154570
127107
27463
25421
2041
1695

4.4002) 359.0200 (81.5917
352976×
70040
44002
26038
22010
4028
3960
68
44
24
22
2

4.5781) 359.0200 (78.4212
204677×
38530
36624
1906
1831
75
60
15
9
6
5
1
0

~~379.02200~~

0.67875550 — 1.16103840 × 70 = 1.16103740

0.69777610 — 1.22771666 × 26 = 1.22771692

0.71778570

0.73893311 — 1.30552233 × 24 = 1.30552427

0.76131113

0.78500663 — 1.40165900 × 34 = 1.40166624

0.81035335

0.83736611 — 1.52558220 × 32 = 1.52558232

0.86634005

0.89755556

0.93137140 — 1.70115534 × 20 = 1.70115594

0.96824000

1.00872790 — 2.00144350 × 130 = 2.00144450

1.10388221 — 0.53673735

103.8960

35.902) 3356.87 00 (99.40115
3231718 ×
337520
323118
146020
143605
2415 00
35902
52860
35902
10958
99.40115
× 36.782
198850230
8946610035
6858080805
7964060900
2982203395
3.7008) 3656.6 6 7 1 0 8 0 (98.79397
3330722 ×
325447
296064
293831
259056
34775 1
33327 =
1457 90
1 4 5 0 24
3576 68
3330 972
245 860
220 048
23 912
98.79397
× 3.7008
79035176
88914573

1.99947306
0.57795664
2.57742970
.5822 5293
1.99322677
.5937 7224
2.58624401
596 3771
1.98995830
609 9285
2.58859155
611 3725
1.98751557
6247667
2.61228554
627 0452
1.98523372
641 2460
2.62648332
643 4724
1.98301058
658 5074
2.64151826
660 6853
1.98083229
676 6296
2.65746225
678 7550
1.97870075
695 6830
2.67439305
697 7610
1.97662295
715 7527
2.69238222
717 7870
1.97459542

26
2.621
206
2.527
8721
230
8960
4469
120
4589
0354
90
6474
5935
130
6065
1666
26
1892
9948
165
10056
5232
109
5427

1.97445952
7369380
2.71153332
7389311
1.97226021
7593365
2.73319677
7613113
1.97065654
7831661
2.75381165
7550663
1.96875002
8084811
2.77523113
8103315
1.96658778
8355326
2.80234098
8376611
1.96504987
8645407
2.82958984
8663405
1.96324989
8857871
2.85803366
8975556
1.96149805
9296382
2.88119196
9313714
1.95997476

1.95997476
966 5359
2.92628335
968 2460
1.95804335
1.0076561
2.96564996
.0087279
1.95637717
1.05519624
3.00833341
1.05360654
1.95347287
1.102 2827
3.05501174
1.103 8960
1.95311154
1.15945850
3.1125743
1.16510474
1.95152659
1.22560551
3.177 1334
1.227 1662
1.94994642
1.304 0056
3.253 8628
1.305 5427
1.94894271
1.400 1493
3.3485764
1.401 6624
1.94469140

778
276
1054

1.94469140
1.5249 3377
3.47125517
1.5251 8272
1.94454245
1.5996920
3.64511165
1.701 1594
1.94395571
2.
3.94395571
2.00144451
1.94225120

178

60382
60254
60000
59616
59106
58466
56700
55306
54786
53636
52358
50954
49422
47762
45974
44058
42014
39844
37544
35118
32564
29882
27074
24136
21072
17878
14558
11110
7534
3832
1213250
1514?13?4
338218

2467
2333
.0134
2
.0268

1213250 circular mils.

6.0 ft. long.

.00000302705325
1213250
15135266250
6054106500
908115975
302705325
605410650
302705325
3.672572355562500
60
220.354341333750 lbs.

15-1
14

29
1
30
15
150
30
2/450
225

225
1
224
3
221
135
216

7 14 / 31×30 × 31/2

7/15 × 14/2
30

38??218
776436
776436
890940
1667376

23599
22333
14932
25?02

3832
19160
19160
38320
15

296980
593960
890940

6/225 = .0267	100.2333	100.4800	
	.0267	.0268	
6/224 = .0268	100.2600	100.5068	
	.0268	.0271	
6/221 = .0271	100.2868	100.5339	
	.0271	.0278	
6/216 = .0278	100.3139	100.5617	
	.0278	.0287	
6/209 = .0287	100.3417	100.5904	
	.0287	.0300	
6/200 = .0300	100.3704	100.6204	
	.0300	.0317	
6/189 = .0317	100.4004	100.6521	
	.0317	.0341	
6/176 = .0341	100.4321	100.6862	
	.0341	.0373	
6/161 = .0373	100.4662	100.7235	
	.0373	.0417	
6/144 = .0417	100.5035	100.7652	
	.0417	.0480	
6/125 = .0480	100.5452	100.8132	
	.0480	.0577	
6/104 = .0577	100.5932	100.8709	
	.0577	.0741	
6/81 = .0741	100.6509	100.9450	
	.0741	.1071	
6/56 = .1071	100.7250	101.0521	
	.1071	.2069	
6/29 = .2069	100.8321	101.2590	
	.2069		
	100.9390		

179

180

$$\frac{10000}{1002069} + \frac{1}{100} = \frac{1000000 + 1002069}{1002069}$$

$$2002069)\ 100206900\ (50.0532$$

$$\begin{array}{r} 10034 \\ 100103450 \\ \hline 1064500 \\ 1001034 \\ \hline 63465500 \\ 60062069 \\ \hline 3403430 \\ 2002069 \\ \hline 1401360 \end{array}$$

$$\times\ .1071$$

$$50.1603$$

$$\frac{10000}{501603} + \frac{1}{100} = \frac{1000000 + 501603}{501603}$$

$$1501603)\ 50160300\ (33.4041$$

$$\begin{array}{r} 45048209 \\ \hline 5112210 \\ 4504209 \\ \hline 607001 \\ 2021412 \\ \hline 6759800 \\ 6006412 \\ \hline 753388 \end{array}$$

$$\times\ .0741$$

$$33.4786$$

$$\frac{10000}{334786} + \frac{1}{100} = \frac{1000000 + 334786}{334786}$$

$$1334786)\ 33478600\ (25.0816$$

$$\begin{array}{r} 26695727 \\ \hline 6782873 \\ 6673930 \\ \hline 1089500 \\ 1067828 \\ \hline 21672 \end{array}$$

$$\times\ .0577$$

$$25.1393$$

$$\begin{array}{r} 1334786 \\ \hline 832340 \\ 500871 \end{array}$$

$$\frac{10000}{251393} + \frac{1}{100} = \frac{1000000 + 251393}{251393}$$

$$1251393)\ 25139300\ (20.0891$$

$$\begin{array}{r} 25022786 \\ \hline 1144000 \\ 1002572 \\ \hline 1001144 \\ 1132856 \\ 1001144 \\ \hline 131712 \\ 112623 \\ \hline 19089 \end{array}$$

$$\times\ .0480$$

$$20.1371$$

$$\frac{10000}{201371} + \frac{1}{100} = \frac{1000000 + 201371}{201371}$$

$$1201371)\ 20137100\ (16.7618$$

$$\begin{array}{r} 12013710 \\ \hline 8123390 \\ 7208226 \\ \hline 915164 \\ 840959 \\ \hline 74205 \\ 72822 \\ \hline 2383 \\ 1201 \\ \hline 1182 \\ 1201 \\ \hline 981 \\ 840 \\ \hline 141 \end{array}$$

$$\times\ .0417$$

$$16.8035$$

$$\frac{10000}{168035} + \frac{1}{100} = \frac{1000000 + 168035}{168035}$$

$$1168035)\ 16803500\ (14.3861$$

$$\begin{array}{r} 11680350 \\ \hline 5123150 \\ 4672140 \\ \hline 451010 \\ 350701 \\ \hline 100309 \\ 93929 \\ \hline 7380 \\ 7008 \\ \hline 372 \end{array}$$

$$\times\ .0373$$

$$14.9234$$

$$\begin{array}{r} 1168035 \\ \hline 1484900 \\ 1168035 \end{array}$$

182

$$\frac{10000}{144234} + \frac{1}{100} = \frac{1000000 + 144234}{14423400}$$

```
1144234)14423400(12.6053
        1144234×      .0347
        28856060
        22884685
         6925920
         6654404
          271600
          271122
           33043000
           22884468
           10158320
```

$$\frac{10000}{126394} + \frac{1}{100} = \frac{1000000 + 126394}{12639400}$$

```
1126394)12639400(11.2211
        1126394×      .0317
        1375460
        1126394
         249066
         225278
          23788200
          22527885
           1259320
           1126394
            132926
```

$$\frac{10000}{1125528} + \frac{1}{100} = \frac{1000000 + 1125528}{112552800}$$

```
1125528)112552800(10.1146
        1125528×      .0300
        1275200
        1125528
         1626720
         1125528
          5141920
          4505112
           636808
           565528
            71280
```

$$\frac{10000}{101446} + \frac{1}{100} = \frac{1000000 + 101446}{10144600}$$

183

```
1101446)10144600(9.2103
        9913014
         231586
         220289
          11296
          10144
           1152
           1101
             51
             44
              7
```

$$\frac{10000}{92390} + \frac{1}{100} = \frac{1000000 + 92390}{9239000}$$

```
1092390)9239000(8.4576
        8739120
         499880
         436956
          62924
          54619
           8305
           7646
            659
```

$$\frac{10000}{84854} + \frac{1}{100} = \frac{1000000 + 84854}{8485400}$$

```
1084854)8485400(7.8217
        7598978
         886422
         867883
          18539
          10708
           7831
           1084
           6747
```

$$\frac{10000}{75488} + \frac{1}{100} = \frac{1000000 + 75488}{7548800}$$

```
1075488)7548800(7.2776
        7549416
         299384
         215697
          83687
          75494
           8193
           7549
            644
```

$$184\ \frac{\cancel{10000}}{73044} + \frac{1}{100} = \frac{1000000 + 73044}{7304400}$$

```
1073044) 7304400 (6.8072
         6438264
          8661360
          8584335
           7700800
           7511308
           1899920
```

3.64975 : 3.41645 :: 100.

```
2.0000000
0.5335751
2.5335751
 5622632
1.971319
 8329685
2.5047264
 8396686
1.969611
 8619582
2.8316000
 8635845
1.968015
 8933012
2.8613167
 8948033
1.8655134
 9372471
2.8937605
 9286723
1.9650882
 9642738
2.9293620
 9656250
1.8637370.
 1.0049487
2.9686857
 1.0062349
1.9624508
```

```
1.9624508
1.0503355
3.0124863
1.0571266
1.9672257
1.1005532
3.0617789
1.1017264
1.9600525
1.1579431
3.1179956
1.1580676
1.9589280
1.2243306
3.1832584
1.2253998
1.9578588
1.3029805
3.2608193
1.3039970
1.9568223
1.3993552
3.3561775
1.4003532
1.9555243
1.5230850
3.4796293
```

```
3.4796293
1.5247673
1.9548620
1.6994318
3.6542938
1.7003601
1.9539337
2.0000000
2.9539337
2.0008976
11.8530361
```

```
1.9.6961118
2.
3.9696118
1.9713119
1.9982999
1.9680155
3.9663154
1.9696118
1.9967036
1.9665134
3.9632170
1.9680155
1.9952015
1.9650882
3.9602897
1.9665134
1.9937763
1.9637370
3.9575133
1.9650882
1.9924251
```

(R)

```
1.9924251
1.9624508
3.9548759
1.9637370
1.9911389
1.9612257
3.9523646
1.9624508
1.9899138
1.9600525
3.9499663
1.9612257
1.9887406
1.9558920
3.9476686
1.9600525
1.9876161
1.9557858
3.9455749
1.9558920
1.9865469
1.9556223
3.9433692
1.9557858
1.9855104
1.9555243
3.9411347
1.9556223
1.9845125
1.9554863
3.9399744
1.9555243
1.9835501
```

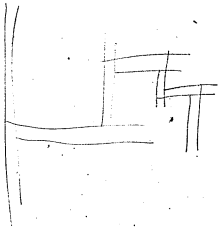
186

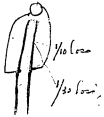
1,9835501
1,95-39337
1,93774838
1,95-48620
1,98262218
1,95-30361
3,93565579
1,95-39337
1,98172242

1,97,13119

4

1,97131 19
2,028 6681
0 28 65 26
35 55





1/30.

188

$m = \frac{10.642L}{R}$

$R = \frac{10.642L}{m}$

$m = 10.642 \times 60 \times \frac{30}{20}$

10.642
180
851360
10642
1915.560

10.642
120
21.2840
10642
1277.0400

$m = \frac{10.642 \times 120}{R} = \frac{1277}{R}$

1277
29
11893
2554
6|37033
6172

1277
56
7662
6385
6|71512
11919

1277
81
1277
10216
6|103437
17239

1277
104
5108
1277
6|132808
22135

1277
125
6385
2554
1277
6|159625
26604

1277
144
5108
5108
1277
6|183888
30648

1277
158
11493
2554
1277
6|201353
40225

1277
3
13831
1277
7662
6385
71543
1277
345
6375
5108
35311
40555

1277
761
1277
7662
1277
6|205597
34266

1277
176
7662
8939
1277
6|224752
37459

1277
200
6|255400
42567

1277
209
11493
2554
6|266893
44482

1277
216
7662
1277
2554
6|275832
45972

1277
221
1277
2554
2554
6|282217
47036

1277
224
5108
2554
2554
6|286048
47675

1277
227
6385
2554
2554
6|287325
47888

1277
930
38310
11493
~~1187670~~
~~1197935~~
~~1595~~
989675
989675
192935
306799 2 In feeding system

In district-
eating system
956686
120
908798
47888

306799 3
4024679
120
30243580
40246790
48296480
1000003 8296480 325
24138074 00
96392290
11488440
24138074 00
33807200 360
96392290
11488440
1488 8431 2403
1488 55
2

14)1187670(84
112
67
56
11
14
25
50 23 36

454399
2

306799 3
4024679
120
30243580
40246790
48296480
1000003 8296480 325
24138074 00
96392290
11488440
24138074 00
33807200 360
96392290
11488440
1488 8431 2403
1488 55
2

190

97.441
14.386
584646
779528
298323
389764
97441
1842.39 / 1402.386226 (97.
1298.106 X
1042802
1009638
331692

4024679
60
241480740
.00000302705325

.00000302705325
4024679
27243479 25
21893727 5
18162318 50
12108213 00
6054106 50
12108213 00
12.182927 6471567 5
60
638.97528
2
1261.9504

84829
1.57
424145
424145
84829
13.14849 5
9566 86
227 X 535.5

12.277
2.255
2.255
6.2888 60
8.800
12.277
2.255
22.5
6.385
2.554
2.554
6.2873 25
4788 8

191

2.000000
8327685
2.832965 85
.8346686
1.998299 9
8619882
2.860285 1
8635845
1.996703 6
8933012
2.890004 8
8948033
1.995201 5

87.601) 96.791 (1.03
87.601
3190 00
2628 03
5719 70
94.31

95.215) 100.00 (1.05
95.215
4785 00
476075

91.513) 95.215 (1.03
91.513
3702 00

121

.166

402
227.153 6
.0000302 7
15900752
4543072
68146.08
68.759 9 9472
60
412.5569 40
2
825.1128

3882 18

2,270,000
3 80
2270
380
2270
380
2
760

192

$\frac{6}{29} = .2069$

$\frac{6}{27} = .2222$

$\frac{6}{25} = .2400$

$\frac{6}{23} = .2608$

$\frac{6}{21} = .2857$

$\frac{2}{19} = .3158$

$\frac{2}{17} = .3529$

$\frac{2}{13} = .3997$

$\frac{6}{13} = .4615$

$\frac{6}{11} = .5455$

$\frac{6}{9} = .6667$

$\frac{6}{7} = .8571$

$\frac{6}{5} = 1.2000$

$\frac{6}{3} = 2.000$

$\frac{6}{1} = 6.$

.50625
6
.03039750
.2333
10.62637

.004444
26666
2333
.26000

.00442979
4
26550
2333
.25979

.0044247778
.02654848674
2333
.2595848
.00442978
6
26550
2333
.2595850
.02654848674

.02655
8072
83375

930) 14.00 (015
930
4700
4650

10.6426
60
63855226
450
3831712
1277704
1277704
6) 1443055.52
240551.
2
48112

225) 6.000000 (26666
4500
1500
1500
1500
1500
1500
.233333
.026666
.233333
.26000

8072
0267
.85339

31) 14.0 (4516
124
16
15.0
50
31
190
186

930) 14
930) 14.00 (015-0)
930
4700
4650
50000

2) 6
225) 6.00 (26666
450
1500
1500
1500

.026666
23333
.1500

2) .026666
.013333
.23333
.2467

5452
0133
5319

5932
0133
5799

6509
0133
6376

7250
0133
7117

8321
0133
8188

9390
0133
9257

2600
2467
.0133

2665
0133
2532

3139
0133
3006

3417
0133
3284

3704
0133
3571

4004
0133
3871

4321
0133
4188

4622
0133
4489

5035
0133
4902

115

10.6426
60
63855226
450
3192600
2554408
6) 2554334.00
4

2,0000000
8329685
2,8329685
8338162
1,9991523
8619882
2,8611405
8635845
1,9975560
8933012
2,8908572
8948033
1,9960539
9272471
2,9233010
9286723
1,9946287
9642738
2,9589025
9656250
1,9932775
1,0049487
2,9982262
1,0062349
1,9919913
1,0500355
3,0420268
1,0512606
1,9907662
1,1005532
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1,2253998
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3,2903598
1,3039970
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1,4003532
1,9853648
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1,9844025
1,6994318
3,6838343
1,7003501
1,9834742
2,0000
3,9834742
2,0008976
1,9825766

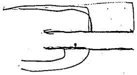
100.
96,068
3.932

100.

95.879

100.
3.932
96.686
96.068
.618
96.472
96.068
.404
96.266
96.068
.198

$\frac{10000}{1002069} + \frac{1}{100} = \frac{1000000+1002069}{10206900}$



$\frac{20000}{1004138} + \frac{1}{200} = \frac{4000000+1004138}{200827600}$

5004138)200827600(39.
150124142
50703460

200

100.
96.068
3.932
99.805
96.068
3.737
99.439
96.068
3.371
99.096
96.068
3.028
98.771
96.068
2.703
98.464
96.068
2.396
98.173
96.068
2.105
97.896
96.068
1.828
97.632
96.068
1.564
97.380
96.068
1.312
97.140
96.068
1.072
96.909
96.068
.841

194

2.0000000
561524.8
2.5615524.8
532.7863
2.02873585
106.841

106.841
96.068
10.773

6.841 3.932
10.773

15 15
14 60
55 15
80 7665
2640 195
120

15
30
1120

2176) 560.00 (.257735
435 2x
1.24400
1.28800
1.6000
1.5332
7650
65 28
11500
10800
6900

2352) 1120.00 (.476.98
940.8x
178220
164688
145160
141112
4880
2352
2128
1881
2469
2116

450) 1.00 (.0133333
450
1500
1350
1500
1350
1500

217) 6.00 (.0276
5.00
1200 0134
1350
7500

4667
0133
4800

4667
0133
4800

Pudis. pyp. 956686

In feeding pyp. 1314865

Each 60 ft. long.

84830
565
4241150
424150
84830
1314865

450
224
221
216
209
220
189
176
161
144
125
104
81
56
29

00000 3027053235
956686
1816231950
2421692600
1816231950
1816231950
15135266625
27243979225
2895793946522950
173756367931770000

00000 3027053235
1314865
15135266625
1816231950
2421692600
1216821300
3027053235
9081159975
3027053235
3.980166371561250
238809982293665000

2240
112
2352

238.81
173.76
412.57
2

525.14

15
14
74
15
224

2120
56
2176

198

~~4762~~ 1120/2352	= .4762	100.4762
		.0286
3/105	= .0286	100.5048
		.0285
3/104	= .0288	100.5336
		.0294
3/102	= .0294	100.5630
		.0303
3/99	= .0303	100.5933
		.0316
3/95	= .0316	100.6249
		.0333
3/90	= .0333	100.6582
		.0357
3/84	= .0357	100.6939
		.0390
3/77	= .0390	100.7329
		.0435
3/69	= .0435	100.7764
		.0500
3/60	= .0500	100.8264
		.0600
3/50	= .0600	100.8864
		.0769
3/39	= .0769	100.9633
		.1111
3/27	= .1111	101.0744
		.2143
3/14	= .2143	101.2887

199

560/2176	= .2574	100.2574
		.1071
3/28	= .1071	100.3645
		.1111
3/27	= .1111	100.4756
		.1200
3/25	= .1200	100.5956
		.1364
3/22	= .1364	100.7320
		.1667
3/18	= .1667	100.8987
		.2308
3/13	= .2308	101.1295
		.4286
3/7	= .4286	101.5581

.158) 100.000 (.0595
.790
1.580
1.580
.0500
.0301
.0200
.0100

200

```
  454399
   23944
  478343
```

In dis, system
2nd 86.878 lbs.

In feeding system
2nd 119,405 lbs.

6/225 = 10/168

168 | 10.000000 (.06
      10 08

225 | 6.000 (.0666
      5 500
      1 350
      1 350

```
 .00000 30270532 5
        21454
 5-95-95-2
 119190
        121082130 0
       1513526625
      121082130 0
     302705325
    6054106 5-0
  .0649424 0 0.425 5 0
      5
  .5-19 5-39.2
      60
 31.17235.52 Ans.
 .00000 30270532 5
        119190
      27243479250
     302705325
   27243479 25
   3027053 25
  302705325
  .3.6 0.7944 8 6 6 6 7 5 9
       60
 21.647668 80 Ans.
```

201

```
   1277
3 | 89839
   2980

   1277
     13
   3831
   1277
3 | 7660 1
   5-5-34
21454
171632

   1277
     18
  10216
   1277
3 | 22986
   7662

   1277
     22
   2554
  2554
3 | 28094
   9365

   1277
     25
3 | 31925
  10642

   1277
     27
   8939
  2554
3 | 34479
  11493

   1277
     28
  10216
  2554
3 | 35756
  11919

   1277
     65
  10216
   7662
   1277
10 | 21456
   21459
```

In feeding system
1st 31.172 lbs.

In dis, system
1st 21.648 lbs.

```
31.172
21.648
86.878
119.405
259.103
```

518.206

x E-172

Table of Volt-ohms-Foot-lbs.

Volts	Squared	Logarithm (1 Volt-ohm per minute = 44.3; log = 1.646404)	Foot-lbs.	
1	1	0.000000	44.3	1
		1.646404		
2	4	0.602060		
		2.248464	177.2	2
3	9	0.954243		
		2.600647	398.7	3
4	16	1.204120		
		2.850524	708.8	4
5	25	1.397940		
		3.044364	1107.5	5
6	36	1.556303		
		3.202767	1594.8	6
7	49	1.690196		
		3.336600	2170.7	7
8	64	1.806180		
		3.452584	2835.2	8
9	81	1.908485		
		3.554889	3588.3	9
10	100	2.000000		
		3.646404	4430.0	10
11	121	2.082785		
		3.729189	5360.3	11
12	144	2.158363		
		3.804767	6379.2	12
13	169	2.227887		
		3.874291	7486.7	13
14	196	2.292256		
		3.938660	8682.8	14
15	225	2.352183		
		3.998587	9967.5	15
16	256	2.408240		
		4.054646	11341.	16
17	289	2.460898		
		4.107302	12803.	17
18	324	2.510545		
		4.156949	14353.	18
19	361	2.557507		
		4.203911	15992.	19
20	400	2.602060		
		4.248464	17720.	20
21	441	2.644439		
		4.290843	19536	21
22	484	2.684845		
		4.331249	21441	22
23	529	2.723456		
		4.369860	23435	23
24	576	2.760422		
		4.406826	25519	24
25	625	2.795880		
		4.442284	27689	25

Roots.	Squares.	Logarithms	Prod.-Logs.	
26	676	2,829947 4,476351	29947	26
27	729	2,862728 4,509132	32295	27
28	784	2,894316 4,540720	34732	28
29	841	2,924796 4,571200	37256	29
30	900	2,954243 4,600647	39870	30
31	961	2,982723 4,629127	42572	31
32	1024	3,010300 4,656704	45363	32
33	1089	3,037028 4,683432	48243	33
34	1156	3,062958 4,709362	51212	34
35	1225	3,088136 4,734540	54268	35
36	1296	3,112605 4,759009	57413	36
37	1369	3,136403 4,782807	60647	37
38	1444	3,159567 4,805971	63969	38
39	1521	3,182129 4,828533	67380	39
40	1600	3,204120 4,850524	70880	40
41	1681	3,225568 4,871972	74469	41

Volts	Squared	Logarithm	Foot-lbs.	
42	1764	3.246499 4.892903	78145	42
43	1849	3.266937 4.913341	81911	43
44	1936	3.286905 4.933309	85765	44
45	2025	3.306425 4.952829	89708	45
46	2116	3.325516 4.971920	93739	46
47	2209	3.344196 4.990600	97859	47
48	2304	3.362483 5.008887	102070	48
49	2401	3.380392 5.026796	106360	49
50	2500	3.397940 5.044344	109760	50
51	2601	3.415140 5.061544	115220	51
52	2704	3.432007 5.078411	119790	52
53	2809	3.448552 5.094956	124440	53
54	2916	3.464788 5.111192	129180	54
55	3025	3.480725 5.127129	134010	55

282

Volts	Squared	Logarithm	Foot-lbs.	
56	3136	3.496376 5.142780	138920	56
57	3249	3.511750 5.158154	143930	57
58	3364	3.526856 5.173260	149030	58
59	3481	3.541704 5.188108	154210	59
60	3600	3.556303 5.202707	159480	60
61	3721	3.570660 5.217064	164840	61
62	3844	3.584783 5.231187	170290	62
63	3969	3.598681 5.245085	175830	63
64	4096	3.612360 5.258764	181450	64
65	4225	3.625827 5.272231	187170	65
66	4356	3.639089 5.285493	192970	66
67	4489	3.652150 5.298554	198860	67
68	4624	3.665018 5.311422	204840	68
69	4761	3.677698 5.324102	210910	69
70	4900	3.690196 5.336600	217070	70

Volts	Squared	Logarithm	Tool-lbs.	
71	5041	3,7025517 5,3478921	223320	71
72	5184	3,7146655 5,3610699	229650	72
73	5329	3,7266446 5,3730550	236080	73
74	5476	3,7384663 5,3848997	242590	74
75	5625	3,7501723 5,3965247	249190	75
76	5776	3,7616627 5,4080031	255880	76
77	5929	3,7729952 5,4193386	262660	77
78	6084	3,7841189 5,4305593	269520	78
79	6241	3,7952255 5,4418165	276470	79
80	6400	3,8061800 5,4525584	283520	80
81	6561	3,8169970 5,4633374	290650	81
82	6724	3,8276628 5,4740032	297870	82
83	6889	3,8381156 5,4845560	305180	83
84	7056	3,8485559 5,4949963	312580	84
85	7225	3,8588838 5,5052242	320070	85
86	7396	3,8689997 5,5154401	327640	86

Volts	Squared	Logarithm	Footlbs.	
87	7569	3.879039 5.525743	335310	87
88	7744	3.888965 5.535369	343060	88
89	7921	3.898780 5.545184	350900	89
90	8100	3.908485 5.554889	358830	90
91	8281	3.918083 5.564487	366850	91
92	8464	3.927576 5.573980	374960	92
93	8649	3.936967 5.583371	383150	93
94	8836	3.946256 5.592660	391440	94
95	9025	3.955447 5.601851	399820	95
96	9216	3.964543 5.610947	408270	96
97	9409	3.973544 5.619948	416820	97
98	9604	3.982452 5.628856	425460	98
99	9801	3.991270 5.637674	434190	99
100	10000	4.000000 5.646404	443000	100

Volts	Squared	Logarithm	Foot-lbs.
101	10201	4.0086427 5.6550464	101 451900
102	10404	4.0172003 5.6636040	102 460900
103	10609	4.0256744 5.6720781	103 469980
104	10816	4.0340667 5.6804704	104 479150
105	11025	4.0423786 5.6887823	105 488410
106	11236	4.0506117 5.6970154	106 497750
107	11449	4.0587676 5.7051713	107 507190
108	11664	4.0668475 5.7132512	108 516720
109	11881	4.0748530 5.7212567	109 526330
110	12100	4.0827854 5.7291891	110 536030
111	12321	4.0906460 5.7370497	111 545820
112	12544	4.0984360 5.7448397	112 555700
113	12769	4.1061569 5.7525606	113 565590
114	12996	4.1138097 5.7602134	114 575720
115	13225	4.1213957 5.7677994	115 585870

12

Roots	Squares	Logarithm	Roots	Lbs.
116	13456	4.1289160		
		5.7753197	116	596100
117	13689	4.1363717		
		5.7827754	117	606420
118	13924	4.1437640		
		5.7901677	118	616830
119	14161	4.1510439		
		5.7974976	119	627330
120	14400	4.1583625		
		5.8047662	120	637920
121	14641	4.1655707		
		5.8119744	121	648600
122	14884	4.1727197		
		5.8191234	122	659360
123	15129	4.1798102		
		5.8262139	123	670210
124	15376	4.1868434		
		5.8332471	124	681160
125	15625	4.1938200		
		5.8402237	125	692190
126	15876	4.2007411		
		5.8471448	126	703310
127	16129	4.2076074		
		5.8540111	127	714520
128	16384	4.2144199		
		5.8608236	128	725810
129	16641	4.2211794		
		5.8675831	129	737200
130	16900	4.2278867		
		5.8742904	130	748670

Volts	Squared	Logarithm	Foot-lbs.
131	17161	4.2345426 5.8809463	131 760230
132	17424	4.2412226 5.8876263	132 772020
133	17689	4.2477033 5.8941070	133 783820
134	17956	4.2542096 5.9006133	134 795450
135	18225	4.2606675 5.9070712	135 807370
136	18496	4.2670778 5.9134815	136 819370
137	18769	4.2734411 5.9198448	137 831470
138	19044	4.2797582 5.9261619	138 843650
139	19321	4.2860296 5.9324333	139 855920
140	19600	4.2922561 5.9386598	140 868280
141	19881	4.2984382 5.9448419	141 880730
142	20164	4.3045767 5.9509804	142 893260
143	20449	4.3106721 5.9570758	143 905890
144	20736	4.3167250 5.9631287	144 918600
145	21025	4.3227360 5.9691397	145 931410

3576
3214
362 =
430

4100909
1106578
31
425

7866
7955
78
415

1883

4[illegible]
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77
4[illegible]
77
6[illegible]
30
408
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3[illegible]
4[illegible]

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1869
261
[illegible]

19
[illegible]
20
353

975
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[illegible]
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437
131
306
383

Roots.	Squares	Logarithm	Fort-Ulz.
146	213.16	4.3287057 5.9751094	146 944300
147	21609	4.3346347 5.9810384	147 957280
148	21904	4.3405234 5.9869271	148 970350
149	22201	4.3463725 5.9927762	149 983500
150	22500	4.3521825 5.9985862	150 996750
151	22801	4.3579539 6.0043576	151 1010080
152	23104	4.3636872 6.0100909	152 1023500
153	23409	4.3693829 6.0157866	153 1037020
154	23716	4.3750414 6.0214451	154 1050620
155	24025	4.3806634 6.0270671	155 1064300
156	24336	4.3862492 6.0326529	156 1078090
157	24649	4.3917993 6.0382030	157 1091950
158	24964	4.3973142 6.0437179	158 1105950
159	25281	4.4027942 6.0491979	159 111995[illegible]
160	25600	4.4082400 6.0546437	160 1134[illegible]

Volts	Squared	Logarithm	Ans-Ohms
161	25921	4.4136578 6.0600555	161 1148300
162	26244	4.4190300 6.0654337	162 1162610
163	26569	4.4243752 6.0707789	163 1177000
164	26896	4.4296877 6.0760914	164 1191480
165	27225	4.4349679 6.0813716	165 1206010
166	27556	4.4403318 6.0867275	166 1221170
167	27889	4.4454329 6.0918366	167 1235480
168	28224	4.4509262 6.0973299	168 1251210
169	28561	4.4557734 6.1021771	169 1265250
170	28900	4.4608978 6.1073015	170 1280270
171	29241	4.4659922 6.1123959	171 1295370
172	29584	4.4710569 6.1174606	172 1310570
173	29929	4.4760922 6.1224959	173 1325850
174	30276	4.4810985 6.1275022	174 1341230
175	30625	4.4860761 6.1324798	175 1356690
176	30976	4.4910253 6.1374290	176 1372230

Volts	Squared	Logarithm	Foot-lbs
177	31329	4.4959465 6.1923502	177 1387870
178	31684	4.5008400 6.1972937	178 1403600
179	32041	4.5057061 6.1521898	179 1419420
180	32400	4.5105450 6.1569987	180 1435320
181	32761	4.5153571 6.1617608	181 1451310
182	33124	4.5201428 6.1665465	182 1467390
183	33489	4.5249022 6.1713059	183 1483560
184	33856	4.5296356 6.1760393	184 1499820
185	34225	4.5343435 6.1807472	185 1516170
186	34596	4.5390259 6.1854296	186 1532600
187	34969	4.5436832 6.1900869	187 1549130
188	35344	4.5483157 6.1947194	188 1565740
189	35721	4.5529236 6.1993273	189 1582440
190	36100	4.5575072 6.2039109	190 1599230
191	36481	4.5620667 6.2084704	191 1616110
192	36864	4.5666025 6.2130062	192 1634080

2220072
2219877
195

155
155
73

362
264
98

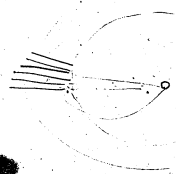
341
248
93

Volts	Squared	Logarithms	Foot-lbs.
193	37249	4.5711146 6.2175183	193 1650130
194	37636	4.5756035 6.2220072	194 1667300
195	38025	4.5800692 6.2264729	195 1684570
196	38416	4.5845521 6.2309158	196 1701830
197	38809	4.5888325 6.2353362	197 1719240
198	39204	4.5933309 6.2397341	198 1736740
199	39601	4.5977062 6.2441099	199 1754320
200	40000	4.6020600 6.2484637	200 1772000

Feb. 8th 1880,

Volts.	Foot-lbs.	Volts.	Foot-lbs
201	1789760	218	2105320
202	1807600	219	2124680
203	1825560	220	2144120
204	1843600	221	2163660
205	1861720	222	2183280
206	1879920	223	2203000
207	1898220	224	2222800
208	1916600	225	2242540
209	1935080	226	2262360
210	1953640	227	2282580
211	1972280	228	2302880
212	1991000	229	2323140
213	2002650	230	2343480
214	2014380	231	2363900
215	2036590	232	2384400
216	2058880	233	2404000
217	2082060	234	2425680
		235	2446460

Volts	Foot-lbs.	Volts	Foot-lbs.
236	2467320	252	2813240
237	2488280	253	2835620
238	2509320	254	2858080
239	2530460	255	2880620
240	2551680	256	2903240
241	2573000	257	2925980
242	2594400	258	2948800
243	2615880	259	2971700
244	2637440	260	2994680
245	2659100	261	3017760
246	2680840	262	3040920
247	2702700	263	3064460
248	2724640	264	3088080
249	2746660	265	3111240
250	2768760	266	3134480
251	2790980	267	3158100



Volts.	Foot-lbs.	Volts.	Foot-lbs.
268	3181800	283	3547940
269	3205600	284	3573040
270	3229480	285	3598260
271	3253440	286	3623560
272	3277480	287	3648940
273	3301640	288	3674400
274	3325880	289	3699980
275	3350200	290	3725640
276	3374600	291	3751380
277	3399100	292	3777200
278	3423680	293	3803120
279	3448360	294	3829120
280	3473120	295	3855220
281	3497980	296	3881400
282	3522920	297	3907660
		298	3934000
		299	3960460
		300	3987000

257

Volts	Foot-lbs.	Volts	Foot-lbs.
301	4013620	318	4479800
302	4040320	319	4508020
303	4067120	320	4536320
304	4094000	321	4564720
305	4121000	322	4593200
306	4148080	323	4621780
307	4175240	324	4650440
308	4202480	325	4679180
309	4229800	326	4708000
310	4257200	327	4736920
311	4284740	328	4765920
312	4312360	329	4794980
313	4340040	330	4824040
314	4367800	331	4854320
315	4395760	332	4884680
316	4423800	333	4913260
317	4451760	334	4941920
		335	4973340

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2113571375 0
1907043575 75
20652817750
19070435475
1582387275 0
1583258092 5
2812618250
8475749100
12069869150 0
12713623650
16550678500
14832560925
17181175750
6585149820 0
2297577500
2118937275

Volts.	Foot-lb.	Volts.	Foot-lb.
336	5004840	353	5520160
337	5032880	354	5551480
338	5061000	355	5582900
339	5091000	356	5614400
340	5121080	357	5646000
341	5151240	358	5677680
342	5181480	359	5709440
343	5211840	360	5741280
344	5242280	361	5773220
345	5272800	362	5805240
346	5303400	363	5837360
347	5334120	364	5869560
348	5364920	365	5901860
349	5395800	366	5934240
350	5426760	367	5966720
351	5457840	368	5999280
352	5488920	369	6031940
		370	6064680

212

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       136700
     218720
     27340
     27340
12124 / 3240.3368 \ 26727
        24248
         81553
         72744
          85096
          84868
           32288
           24248
            80.00
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Velocity	Foot-lbs.	Velocity	Foot-lbs.
371	6097000	388	6669200
372	6130400	389	6703580
373	6163420	390	6738040
374	6196520	391	6772640
375	6229700	392	6807320
376	6262960	393	6842100
377	6296320	394	6876960
378	6329760	395	6911920
379	6363300	396	6946960
380	6396920	397	6982080
381	6430640	398	7017280
382	6464440	399	7052600
383	6500340	400	7088000
384	6536320		
385	6568380		
386	6600520		
387	6634820		

Volts.	Foot-lbs.	Volts.	Foot-lbs.
401	7123480	417	7703320
402	7159040	418	7740320
403	7194680	419	7777400
404	7230400	420	7814560
405	7266280	421	7851800
406	7302240	422	7889120
407	7338280	423	7926520
408	7374400	424	7964000
409	7410600	425	7987280
410	7446880	426	8010600
411	7483260	427	8034020
412	7519680	428	8057520
413	7556280	429	8101900
414	7592880	430	8146360
415	7629600	431	8190900
416	7666400	432	8235520
		433	8281840
		434	8328240

Volts.	Foot-lbs.	Volts.	Foot-lbs.
435	8374720	451	901.0210
436	8421280	452	9049440
437	8459960	453	9089840
438	8498720	454	9130320
439	8537580	455	9170880
440	8576480	456	9211520
441	8615520	457	9252000
442	8654640	458	9292560
443	8693840	459	9333200
444	8733120	460	9373920
445	8772520	461	9414720
446	8812000	462	9455600
447	8851600	463	9496580
448	8891200	464	9537600
449	8931090	465	9578780
450	8970160	466	9620000
		467	9661320

Vol.	Foot-lbs.	Vol.	Foot-lbs.
468	9702720	485	10420520
469	9744240	486	10463520
470	9785840	487	10506600
471	9827520	488	10549760
472	9869280	489	10593040
473	9911160	490	10636400
474	9953120	491	10679840
475	9995160	492	10723360
476	10037280	493	10767040
477	10079520	494	10810800
478	10121840	495	10854640
479	10164240	496	10898560
480	10206720	497	10942560
481	10249320	498	10986640
482	10292000	499	11030800
483	10334760	500	11075040
484	10377600		

Feb. 1880.

Table of Resistances for Varying temperature.

Conductivity of Copper taken at 97 therefore resistance at 0°C. = .21278 ohms per foot-gram.

Mathiessen's formula for resistance is $R = r(1 + at \pm bt^2)$, in which r is the resistance (.21278) at 0°C. The formula for Fahrenheit becomes

$$R = r\left[1 + \tfrac{5}{9}a(t-32) \pm b\left(\tfrac{5}{9}\right)^2(t-32)^2\right].$$

$a = .003824$, $b = .00000126$

$$\therefore R = .21278\left[1 + .0021244(t-32) + .0000003889(t-32)^2\right]$$

In this table the column of ratios is true for any metal but not for alloys. Let R' be the resistance of 1 foot 1 gram of any copper and R the resistance for any temperature as found in Col. 3. Then

$$R' = \frac{R \times 97}{C}.$$

It would be nice to have a column for mil-feet; and also the even C. degrees.

April 2, 1890. Clarke.

Note Book 55.

The weight of a mil-foot of copper is .021189372 75 grains and in one gram-foot there will be 47.193469 mil-feet, therefore to find the resistance per mil-foot of copper having a conductivity of 97, multiply the resistance at any desired temperature as found in Col. 3 by 47.193469. or if the copper have a different conductivity C, applying formula on preceding page we have,

$$\text{Res. per mil-foot} = 47.193469\left(\frac{R \times 97}{C}\right).$$

Since a mil-foot of copper of a sp. gr. of 8.899 weighs .021189372 75 grains the weight of any other metal per mil-foot having a sp. gr. of S will be

$$\frac{.021189372\,75 \times S}{8.899} = .002381096\,S \text{ grains}$$

See 6 pages ahead

Temp. Fahr.	Temp. Cent.	Resistance per Foot-gram	Rates of Resistance to Resistance at 60° F.	Temp. Fahr.	Temp. Cent.	Resistance per Foot-gram	Rates of Resistance that at 60° F. being 1
0	-17.78	.19839	.8798	25	-3.89	.20963	.9296
1	-17.22	.19884	.8818	26	-3.33	.21007	.9316
2	-16.67	.19929	.8838	27	-2.78	.21052	.9336
3	-16.11	.19973	.8857	28	-2.22	.21097	.9356
4	-15.56	.20018	.8877	29	-1.67	.21141	.9375
5	-15	.20063	.8897	30	-1.11	.21188	.9396
6	-14.44	.20107	.8917	31	-.56	.21233	.9416
7	-13.89	.20152	.8937	32	0	.21278	.9436
8	-13.33	.20197	.8956	33	.56	.21324	.9456
9	-12.78	.20241	.8976	34	1.11	.21368	.9476
10	-12.22	.20286	.8996	35	1.67	.21414	.9496
11	-11.67	.20331	.9016	36	2.22	.21459	.9516
12	-11.11	.20378	.9036	37	2.78	.21505	.9537
13	-10.56	.20422	.9056	38	3.33	.21550	.9557
14	-10	.20467	.9076	39	3.89	.21595	.9577
15	-9.44	.20512	.9096	40	4.44	.21640	.9597
16	-8.89	.20556	.9116	41	5	.21687	.9617
17	-8.33	.20603	.9137	42	5.56	.21731	.9637
18	-7.78	.20648	.9156	43	6.11	.21775	.9656
19	-7.22	.20692	.9176	44	6.67	.21820	.9676
20	-6.67	.20737	.9196	45	7.22	.21867	.9697
21	-6.11	.20780	.9216	46	7.78	.21912	.9717
22	-5.56	.20827	.9236	47	8.33	.21957	.9737
23	-5	.20871	.9256	48	8.89	.22001	.9757
24	-4.44	.20916	.9275	49	9.44	.22048	.9777

S E T

0° to 12° is 21.
12° to 22° is 21.1
22° to 32° is 21.2
32° to 42° is 21.3
42° to 52° is 21.3
52° to 62° is 21.4
62° to 72° is 21.5
72° to 82° is 21.6
82° to 92° is 21.7
92° to 102° is 21.8
102° to 112° is 21.8
112° to 122° is 21.9
122° to 132° is 22.
132° to 142° is 22.1
142° to 152° is 22.1
152° to 162° is 22.2

Temp. of Fahr.	Temp. Cent.	Resistance per Foot-grain	Ratio of Resistance to Resistance at 60°F.
50	10	.22092	.9797
51	10.56	.22138	.98.17
52	11.11	.22182	.9837
53	11.67	.22229	.9858
54	12.22	.22274	.9878
55	12.78	.22321	.9899
56	13.33	.22365	.9918
57	13.89	.22412	.9939
58	14.44	.22459	.9960
59	15	.22504	.9980
60	15.56	.22550	1
61	16.11	.22595	1.0020
62	16.67	.22642	1.0041
63	17.22	.22688	1.0062
64	17.78	.22733	1.0081
65	18.33	.22780	1.0102
66	18.89	.22825	1.0122
67	19.44	.22872	1.0143
68	20	.22916	1.0162
69	20.56	.22963	1.0183
70	21.11	.23008	1.0203
71	21.67	.23055	1.0224
72	22.22	.23099	1.0243
73	22.78	.23144	1.0263
74	23.33	.23189	1.0283

Temp. of Fahr.	Temp. Cent.	Resistance per Foot-grain	Ratio of Resistance to Resistance at 60°F.
75	23.89	.23233	1.0303
76	24.44	.23282	1.0325
77	25	.23329	1.0346
78	25.56	.23374	1.0365
79	26.11	.23421	1.0386
80	26.67	.23468	1.0407
81	27.22	.23512	1.0427
82	27.78	.23559	1.0447
83	28.33	.23606	1.0468
84	28.89	.23651	1.0489
85	29.44	.23697	1.0509
86	30	.23744	1.0529
87	30.56	.23791	1.0550
88	31.11	.23836	1.0570
89	31.67	.23882	1.0591
90	32.22	.23929	1.0612
91	32.78	.23974	1.0631
92	33.33	.24021	1.0652
93	33.89	.24068	1.0673
94	34.44	.24114	1.0693
95	35	.24159	1.0714
96	35.56	.24206	1.0734
97	36.11	.24253	1.0755
98	36.67	.24299	1.0776
99	37.22	.24346	1.0796

162° & 172°	22,3
172° & 182°	22,4
182° & 192°	22,5
192° & 202°	22,5
202° & 212°	22,6
202° & 222°	22,7
222° & 232°	22,8
232° & 242°	22,9
242° & 252°	22,9
252° & 262°	23.
262° & 272°	23,1
272° & 282°	23,2
282° & 292°	23,2
292° & 302°	23,3
300° & 320°	23,45
320° & 340°	23,55
340° & 360°	23,7
360° & 380°	23,9
380° & 400°	24.
400° & 450°	24,3
450° & 500°	24,7

Temp. of Fahr.	Temp. Cent.	Resistance per Ferrigram	Ratio of Resistance to Resistance at 60°F.
100	37.78	.24391	1.0816
101	38.33	.24438	1.0837
102	38.89	.24482	1.0857
103	39.44	.24529	1.0878
104	40	.24576	1.0898
105	40.56	.24621	1.0918
106	41.11	.24665	1.0938
107	41.67	.24714	1.0959
108	42.22	.24761	1.0980
109	42.78	.24808	1.1001
110	43.33	.24853	1.1021
111	43.89	.24900	1.1042
112	44.44	.24946	1.1063
113	45	.24993	1.1083
114	45.56	.25040	1.1104
115	46.11	.25087	1.1125
116	46.67	.25134	1.1146
117	47.22	.25180	1.1166
118	47.78	.25225	1.1186
119	48.33	.25272	1.1207
120	48.89	.25319	1.1228
121	49.44	.25366	1.1248
122	50	.25412	1.1270
123	50.56	.25459	1.1290
124	51.11	.25506	1.1312

Temp. of Fahr.	Temp. Cent.	Resistance per Ferrigram	Ratio of Resistance to Resistance at 60°F.
125	51.67	.25553	1.1332
126	52.22	.25600	1.1353
127	52.78	.25646	1.1373
128	53.33	.25693	1.1394
129	53.89	.25740	1.1415
130	54.44	.25787	1.1436
131	55	.25834	1.1456
132	55.56	.25880	1.1477
133	56.11	.25927	1.1498
134	56.67	.25974	1.1518
135	57.22	.26021	1.1539
136	57.78	.26068	1.1560
137	58.33	.26117	1.1582
138	58.89	.26163	1.1602
139	59.44	.26210	1.1623
140	60	.26257	1.1644
141	60.56	.26304	1.1665
142	61.11	.26351	1.1685
143	61.67	.26397	1.1706
144	62.22	.26444	1.1727
145	62.78	.26491	1.1748
146	63.33	.26537	1.1768
147	63.89	.26586	1.1790
148	64.44	.26633	1.1812
149	65	.26680	1.1832

and in one grain foot there will be $\frac{1}{.002381096\,S} = \frac{419.9746781}{S}$ mile-feet. If then we have given at any temperature the resistance, B, of any metal per grain foot, the resistance per mile-foot will be at that temperature

$$\frac{B}{S}(419.9746781).$$

Col. 4, holds good for the mile-foot as well as for the grain foot.

Let R be the resistance of any metal, at a given temperature per mile-foot, or grain-foot and m the corresponding ratio in Col. 4, also n the ratio corresponding to any other temperature and R' the resistance per mile-foot or grain-foot for that temperature then will

$$R' = \frac{Rn}{m}.$$

Temp. Fahr.	Temp. Cent.	Resistance per Foot-grain	Ratio of Resistance to Resistance at 60° F.	Temp. Fahr.	Temp. Cent.	Resistance per Foot-grain	Ratio of Resistance to Resistance at 60° F.
150	65.56	.26727	1.1852	175	79.44	.27910	1.2377
151	66.11	.26774	1.1873	176	80	.27959	1.2399
152	66.67	.26820	1.1894	177	80.56	.28006	1.2419
153	67.22	.26867	1.1915	178	81.11	.28052	1.2440
154	67.78	.26914	1.1935	179	81.67	.28101	1.2462
155	68.33	.26963	1.1957	180	82.22	.28148	1.2483
156	68.89	.27010	1.1978	181	82.78	.28197	1.2504
157	69.44	.27057	1.1999	182	83.33	.28244	1.2525
158	70	.27103	1.2019	183	83.89	.28293	1.2547
159	70.56	.27150	1.2040	184	84.44	.28340	1.2568
160	71.11	.27199	1.2062	185	85	.28389	1.2589
161	71.67	.27246	1.2082	186	85.56	.28435	1.2610
162	72.22	.27293	1.2103	187	86.11	.28484	1.2632
163	72.78	.27340	1.2124	188	86.67	.28531	1.2652
164	73.33	.27388	1.2146	189	87.22	.28580	1.2674
165	73.89	.27436	1.2166	190	87.78	.28627	1.2695
166	74.44	.27482	1.2187	191	88.33	.28676	1.2716
167	75	.27531	1.2209	192	88.89	.28723	1.2737
168	75.56	.27578	1.2230	193	89.44	.28772	1.2759
169	76.11	.27625	1.2250	194	90	.28819	1.2780
170	76.67	.27672	1.2271	195	90.56	.28867	1.2801
171	77.22	.27720	1.2293	196	91.11	.28914	1.2822
172	77.78	.27767	1.2314	197	91.67	.28963	1.2844
173	78.33	.27814	1.2334	198	92.22	.29010	1.2865
174	78.89	.27863	1.2356	199	92.78	.29059	1.2887

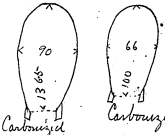
Temp. of Fahr.	Temp. Cent.	Resistance per Foot-gram	Ratio of Resistance to Resistance at 60°F.	Temp. of Fahr.	Temp. Cent.	Resistance per Foot-gram	Ratio of Resistance to Resistance at 60°F.
200	93.33	.29106	1.2907	225	107.22	.30310	1.3441
201	93.89	.29155	1.2929	226	107.78	.30359	1.3463
202	94.44	.29201	1.2950	227	108.33	.30408	1.3485
203	95	.29250	1.2971	228	108.89	.30455	1.3505
204	95.56	.29297	1.2992	229	109.44	.30504	1.3527
205	96.11	.29346	1.3014	230	110	.30553	1.3549
206	96.67	.29393	1.3035	231	110.56	.30599	1.3570
207	97.22	.29442	1.3056	232	111.11	.30648	1.3591
208	97.78	.29491	1.3078	233	111.67	.30697	1.3613
209	98.33	.29538	1.3099	234	112.22	.30746	1.3635
210	98.89	.29587	1.3120	235	112.78	.30795	1.3656
211	99.44	.29634	1.3139	236	113.33	.30844	1.3678
212	100	.29682	1.3163	237	113.89	.30893	1.3700
213	100.56	.29731	1.3185	238	114.44	.30940	1.3720
214	101.11	.29778	1.3205	239	115	.30989	1.3742
215	101.67	.29827	1.3227	240	115.56	.31038	1.3764
216	102.22	.29876	1.3249	241	116.11	.31087	1.3786
217	102.78	.29925	1.3271	242	116.67	.31136	1.3807
218	103.33	.29972	1.3291	243	117.22	.31184	1.3829
219	103.89	.30021	1.3313	244	117.78	.31233	1.3851
220	104.44	.30070	1.3335	245	118.33	.31282	1.3872
221	105	.30116	1.3355	246	118.89	.31331	1.3894
222	105.56	.30165	1.3377	247	119.44	.31380	1.3916
223	106.11	.30214	1.3398	248	120	.31427	1.3937
224	106.67	.30261	1.3420	249	120.56	.31476	1.3958

Temp. Fahr.	Temp. Cent.	Resistance per Foot-gram	Ratio of Resistance to Resistance at 60°F.	Temp. Fahr.	Temp. Cent.	Resistance per Foot-gram	Ratio of Resistance to Resistance at 60°F.
250	121.11	.31525	1.3980	275	135	.32753	1.4524
251	121.67	.31574	1.4002	276	135.56	.32802	1.4546
252	122.22	.31623	1.4023	277	136.11	.32851	1.4568
253	122.78	.31672	1.4045	278	136.67	.32899	1.4590
254	123.33	.31721	1.4067	279	137.22	.32948	1.4611
255	123.89	.31770	1.4089	280	137.78	.32998	1.4634
256	124.44	.31819	1.4110	281	138.33	.33048	1.4656
257	125	.31867	1.4132	282	138.89	.33095	1.4676
258	125.56	.31916	1.4154	283	139.44	.33144	1.4698
259	126.11	.31965	1.4175	284	140	.33193	1.4720
260	126.67	.32014	1.4197	285	140.56	.33244	1.4742
261	127.22	.32063	1.4219	286	141.11	.33293	1.4764
262	127.78	.32112	1.4240	287	141.67	.33342	1.4786
263	128.33	.32161	1.4262	288	142.22	.33391	1.4808
264	128.89	.32210	1.4284	289	142.78	.33440	1.4829
265	129.44	.32259	1.4306	290	143.33	.33491	1.4852
266	130	.32308	1.4327	291	143.89	.33540	1.4874
267	130.56	.32359	1.4350	292	144.44	.33589	1.4895
268	131.11	.32408	1.4372	293	145	.33638	1.4917
269	131.67	.32457	1.4393	294	145.56	.33689	1.4940
270	132.22	.32506	1.4415	295	146.11	.33738	1.4961
271	132.78	.32555	1.4437	296	146.67	.33787	1.4983
272	133.33	.32604	1.4459	297	147.22	.33838	1.5006
273	133.89	.32653	1.4480	298	147.78	.33887	1.5027
274	134.44	.32702	1.4502	299	148.33	.33936	1.5049

Temp. Temp. Fahr.	Cent.	Resistance per Foot-gram	Ratio of Resistance to Resistance at 60°F.	Temp. Temp. Fahr.	Cent.	Resistance per Foot-gram	Ratio of Resistance to Resistance at 60°F.
300	148.89	.33985	1.5071	450	232.22	.41619	1.8456
305	151.67	.34234	1.5181	460	237.78	.42145	1.8689
310	154.44	.34482	1.5291	470	243.33	.42670	1.8922
315	157.22	.34731	1.5402	480	248.89	.43196	1.9156
320	160	.34982	1.5513	490	254.44	.43721	1.9389
325	162.78	.35231	1.5624	500	260	.44245	1.9621
330	165.56	.35483	1.5735				
335	168.33	.35734	1.5846				
340	171.11	.35985	1.5958				
345	173.89	.36238	1.6070				
350	176.67	.36489	1.6181				
355	179.44	.36742	1.6294				
360	182.22	.36993	1.6405				
365	185	.37249	1.6518				
370	187.78	.37502	1.6630				
375	190.56	.37757	1.6744				
380	193.33	.38001	1.6856				
385	196.11	.38266	1.6969				
390	198.89	.38521	1.7082				
395	201.67	.38776	1.7195				
400	204.44	.39032	1.7309				
410	210	.39549	1.7538				
420	215.56	.40066	1.7768				
430	221.11	.40583	1.7997				
440	226.67	.41100	1.8226				

March 14th 1889

Carbon Loop

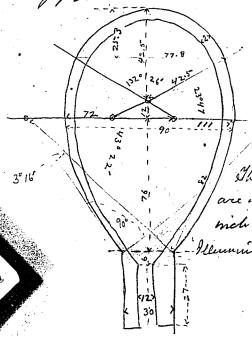


Not Carbonized — Carbonized

The mills are $80\frac{1}{100}$ of an inch.

The ratio of contraction by carbonizing is $\frac{4}{15}$.

March 15-4



Before embouchure

The dimensions are in 80th of an inch.

191.8
117.86
332.
(64000) 142,66 (.1004156 Surface in
64000
256000 face before car-
256000 bouzing.
10000
64000
360000
320000
40000
32000
8000
1600.0

Since the calculations have been made in 80th, we divide by (80)²:

Fig 2

2.1332.5
77.8

42.5)38.39(.9150588
38 25
670
425
2550
2125
2500
2125
3750
3400
3750
3400
3500
3400
100

132°26'
66°13'
23°47'

2.1332
43.22

5184
1960
284

111)41.0(.3693693
333
770
666
1040
888
1520
1332
1880
1665
2150

1806.25
1640.25
166.00

3.1416
166
188496
31416
521.5056

7946
5.2.21
39730
7946
15892
39730
216000) 47438.39 (191.8
216
1783
1728
398
216
1824
1728
969

3.1416
260
12566
251328
62832
8220.1.44

2854
592
5708
25686
22832
216000) 25457.68 (117.86
216000
38576
21600
169776
151200
185680
172800
12880.00

12321
11520
800

3.1416
260
125660
125660
13823.560

10908
4192
1256
1320
216000) 1320 (.333
1296
24
1.3
3.9
3.51
3.60

3000
2160
840

132°26'
66
7946
23°47'
7427
2854

12321
2.0.3
1320
1382

222

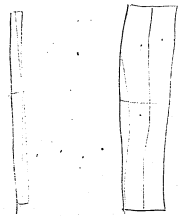
Shrinkage by Carbonizing

The linear dimensions diminish to $\frac{11}{15}$ th. and areas therefore are $\frac{121}{225}$ th of their value before carbonizing.

.10041 5-6
121
10041 5-6
20083 12
10041 5-6

225) 12.15028 78 (.05-4001
11 25 × × × ×
900
900
287

The area of the face of loop is therefore .054 sq. in.



$\frac{9000}{8000} = 1.125$

$\frac{9350}{8000} = 1.169$

$\frac{10250}{8000} = 1.281$

$\frac{11550}{8000} = 1.444$

$\frac{12650}{8000} = 1.581$

$\frac{13150}{8000} = 1.644$

$\frac{13050}{8000} = 1.631$

$\frac{12430}{8000} = 1.554$

$\frac{11150}{8000} = 1.394$

$\frac{9450}{8000} = 1.181$

$\frac{9220}{8000} = 1.154$

$\frac{7400}{8000} = 0.925$

$\frac{7700}{8000} = 0.963$

$\frac{5150}{8000} = 0.644$

$\frac{4450}{8000} = 0.506$

$\frac{3000}{8000} = 0.375$

$\frac{8600}{8000} = 1.750$

$\frac{8950}{8000} = 1.119$

$\frac{10000}{8000} = 1.250$

$\frac{11100}{8000} = 1.388$

$\frac{12350}{8000} = 1.531$

$\frac{12750}{8000} = 1.594$

$\frac{12700}{8000} = 1.588$

$\frac{12270}{8000} = 1.507$

$\frac{10900}{8000} = 1.363$

$\frac{9200}{8000} = 1.150$

$\frac{7800}{8000} = .975$

$\frac{2500}{8000} = .938$

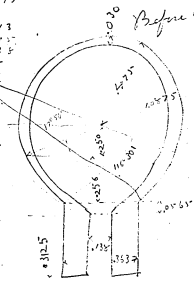
$\frac{6300}{8000} = .788$

$\frac{5000}{8000} = .625$

$\frac{5950}{8000} = .744$

$\frac{2975}{8000} = .372$

Before Carburizing



17°50'
35°40'
60
2140'

3.1416
.06433
1.7080
94248
125664
188496
.20216
214
85664
20216
40432
2160) 43.2622 24 (.02003
4320
6224
6320
1904

.05865
.02003
.07868 is Surface before carbonizing, which multiplied by 171/225 gives .0423 as the area of face of hope after carbonizing.

1.08375
1.05375
54375
76125
57000
10875
1.18265625
1.18306225
.06375
1.05375
1.05375
52875
74025
52875
10575
1.18306225
.07868
15736
7868
225) 9.2625 (.04
900
1320
1125
1950
1800
150

43°22'
38°16'
93°16'
88°44'
93°16'
43°22'
38°16'
76°38'
43°22'
46°38'

1.385
.777
9776
13776
97716
1.009076

1.385
1.009
1379

.9151
.9009
.82347900

.9151
.82346
.09715
.731
.822
1694
150
47
1.156 13
78 91

.6867
1.3836
41336
41336
20601
6867
.7796

.17
.2585 = .731
60 : 1

.731
60

.731) 160 (.20
1462
1200

312

Thickness ~~.00477~~

Thickness before carbonizing .0065

1.631
1.555
3.219
.00349
28.971
12.872
9657
.011234931

.054).011234931(.207
.054
501 11234
224

1.509
1.640
3.173
.00349
28.377
12.612
5659
.054).01168397(.207
54
503
12.2
47

1.363
1.551
2.914
.00349
26.996
11.776
5832
.054).01.7756(.190
54
7
4.7
4.5

1.121
.6615
605
726
225).7545(.00349
675
3.0
3.25
3.20
.1.25
.7.50

1.150
1.496
2.094
.00349
23.346
12.276
5782
.054).0.9.5306(.165
54
3.6
3.6
9.3
5.6
2.5

1.251
.7735
2.256
.00349
20.304
9.024
6768
.054).00873456(.145
54
3.2.7
2.6
3.73
2.0
434

1.169
.785
1.954
.00349
17613
7828
5871
.054).0065293(.121
54
1.1
1.05
.349
3.2
2.5

1.125
.749
1.874
.00349
16821
7476
5607
.054).0065281(.121
54
1
1.0
.72

1.594
1.535
3.129
.00349
28332
12.528
9494
.054).0102856.52(.203
0 54
7.6
1.6
24

1.551
1.363
2.914
.00349
26.996
11.776
5832
.054).0163756(.190
54
7
4.7
4.5
2

1.444
1.510
2.954

1.394
1.531
2.925
.00349
26325
11700
5725
.054).0102852.5(.189
54
6.0
4.5
3.8
4.6
22

1.355
1.551
2.1569
.349
23721
10276
7707
.054).0.8656(.171
54
3.6
3.6
3.2.5
3.0.5

1,250
983
2,213
349
19917
88852
6639
54) 79237 (143
54
232
216
163
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1,119
1806
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17325
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5775
54) 67125 (124
54
135
108
238
216
22
1,075
775
1,850
349
16425
7300
5475
54) 63925 (118
54
99
54
45
1,250
349
10125
4500
3375
054) 392625 (727
378 ×
1868
1890
3528
378
1,169
349
10521
4676
3507
54) 407891 (755
378 ×
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270
29
1,281
349
11529
5124
3843
54) 447069 (82
432 ×
150
108
426
1,444
349
12996
5776
5332
54) 503956 (93
486 ×
176
162
15
1,581
349
14229
6324
4743
54) 551769 (102
54 ×
117
1644
349
14796
6576
4932
54) 573554 (106
54 ×
337
324
13
1,631
348
14679
6524
4893
54) 568932 (105
54 ×
292
270
22
1,354
00349
13936
6216
4662
054) 542296 (100
54 ×
00
22
1394
349
12546
5576
4182
54) 486506 (90
486 ×
20
1,181
349
10629
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3543
54) 412169 (76
378 ×
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963
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8667
3852
2889
54) 336087 (62
324 ×
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806
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2418
54) 281294 (52
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2500
300
54) 261750 (48
216 ×
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7664664

1126
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6756
7168118

1205
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7248
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3624
7248
7690128

1146
6366
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3438
6876
7295436

1203
6350
7218
7218
3609
7218
7658298

1168
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7008
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3504
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7435488

6366
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50928
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1190
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7575540

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1422756

6366
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25464
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7276338

6366
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12732
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6366
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42.5
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413.85

41.5
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2075
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27.9.75

35.4
2.65
70
92.4
368
405.70
413.85
422.875
1244.825

31.5
66.5
1575
1890
146.475

2439.65
275.975
146.475
3.61
141
3369.200

1.56

1.28
.95
576.1
1.5
148.00

1245
71
256

3369.2
124.45
2212.54

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.9550
.00348
85550
3500
2850
.0423) 00331550 (.7854
2961 ×
3595
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1710

.910
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.9615
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86485
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2895
423) 3367815 (796
2961 ×
0685
3507
2581
2581

1.0015
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30045
423) 3107745 (5.29
3384 ×
1234
846
3885

1015
348
91355
4060
30445
423) 3294235 (8.3
3384 ×
1583
1269
3775

.9551
348
55229
3924
2943
423) 3423668 (.80
3384 ×
3949

348
920
6980
3141
423) 3276980 (7.75
3384 ×
2985
2115
3830

8235
348
74235
3300
2475
423) 2875925 (6.8
2538 ×
3472
2538

348
710
13940
2448
423) 2958960 (6.61
2538 ×
4196

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710
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2443
423) 2477908 (5.8
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423) 2087072 (4.9
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3807
1432

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1764
423) 2095212 (4.95
1692 ×
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2172
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950
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4530
423) 5367900 (12.95
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1939
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532000
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423) 5522225 (13.
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423)4247 (147
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423)65785 (155
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423)69339 (157
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423)63437 (150
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423)61773 (146
423
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423)16189 (132
423
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423)1435 (
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423)1342 (
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1126
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716811

1128
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3384
6768
718084

1135
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3405
6810
72254

1148
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6888
3444
6888
73081 6

1156
6366
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6936
7359096

1158
6366
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3474
6948
737188

1155
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3465
6930
7352730

1146
6366
6876
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729541

[illegible]

1133
6366
6798
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3399
6798
7212678

1125

1123
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6738
6738
3369
6738
7149018

1122
6366
6732
6732
3366
6732
71426

1198
42.5
5990
2396
4792
509.150
540.6
539.4
1589.15
13.95
1603.10

42.5
978
3400
2975
3825
4156 50
313.1
198.75
927.50
2
1855.00
320.795
182.70
377.685
159.500
2895.680

17.4
31
174
522
539.4

20.4
26.5
1020
1224
408
540.60

143
136
279
1.3.9.500

10.1
31
101
303
313.1

26.5
7.5
1325
1855
198.75

41.5
7.73
1245
2905
2905
320.795

31.5
5.8
2520
1575
182.70

3.465
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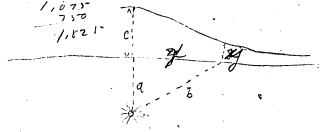
31185
3465
377.685

1.595
100
159.500

1,0725
7,50
1,821



$b^2 = a^2 + x^2$

$y : c :: a^2 : a^2 + x^2$

$y = \frac{a^2 c}{a^2 + x^2}$

$a^2 + y^2$

$a^2 + y^2 = c^2$

$a^2 dy + 2y\,x\,dx + x^2 dy = 0$

$dA = y\,dx$

$a^2 dy + 2x\,dA + x^2 dy = 0$

$2x\,dA = -(a^2 + x^2)\,dy$

$dA = -\frac{(a^2 + x^2)}{2x}\,dy$

$dA = \left(\frac{a^2 c}{2y\,x^2}\right)dx = \frac{d}{dx}\left(\frac{c\,a^2 x}{a^2 + x^2}\right) = 0$

$c\,(d, \ldots)$

1,5358697
1,5333430
2,0867023 27
1,5 y 64
16
9270
2,7 0
2,7 0

$20^0 y^2$
$125^{\ldots}$

10 / 38,28
3,828

75°22
60
45 22''
360
21600

3,1416
10
31,4160

62,8832
4 1 = 2
12,5664
12,5664
31,4160
25,1328
28,4 1,2 6,30 y (13,15
216
16
2,8 1
8
3,2
5,6
6

2,832
13,7

1,3,15
6
7,8 9 0
7,3 5
2,1 6 4 0

$dV = \pi x^2 dy$

$\cancel{dV = \pi a^2 (c - y)\,dy}$

$a^2 y + x^2 y = a^2 c$

$\cancel{x^2 y = a^2 c - a^2 y}$

$\cancel{x^2 = \frac{a^2 c - a^2 y}{y}}$

$dV = \pi a^2 \left(\frac{c\,dy}{y} = \frac{c}{y}\,dy\right).$

$\cancel{V = \pi a^2 c}$

$a^2 dy + 2x\,dx\,y + x^2 dy = 0$

$a^2 dy + 2x\,dx\,y + \frac{dV}{\pi} = 0$

769) 16 0 0 (21
15 3
6 1 0